FLIGHT
& AIRCRAFT ENGINEER

First Aero Weekly in the World

Founder and Editor: STANLEY SPOONER

A Journal devoted to the Interests, Practice, and Progress of Aerial Locomotion and Transport

OFFICIAL ORGAN OF THE ROYAL AERO CLUB OF THE UNITED KINGDOM

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CONTENTS.

EDITORIAL COMMENT

THE *TIMES* of Monday last contains an article on civilian flying, which bears the obvious impress of official inspiration and sets forth what must be assumed to be the concrete intentions of the Government in relation to the future measure of assistance to be given to the movement. It begins by pointing out that there are many beliefs in the public mind that must be dispelled and many erroneous impressions that need correction. It is desirable, therefore, that a survey of the matter generally and a consideration of the many problems ahead should be made at this point in its history. Because flying played so great a part in the defeat of the Central Empires, because the aeroplane has become so common an object, the belief has become current that once peace is definitely signed one will be able to hail an aeroplane at Charing Cross and make forthwith a tour of the European battlefields. It is pointed out that regularity and stability are the two things to be aimed at as the basis of civil aviation. Only the Air Ministry can ensure these, and to thoughtful people it must be apparent that there is still a great mass of pioneer work to be done before the first commercial air service can be opened.

The Future of Civil Flying

The first point to be dealt with is finance. Civil aviation is for the moment an experiment in Government activity. It would, the writer contends, be fatal to spend too much money on it at first, and every pound spent must be accounted for. We are not quite certain about this, inasmuch as it is extremely difficult to say what would be too much, and in our view, bearing in mind the certainty that aviation must develop into a standard means of transport, it would be better to err on the side of generosity than on that of parsimony, which might easily cripple the development of the movement for years to come. However, this point may be allowed to pass for the time being. The article goes on to say that there is no doubt the money will be granted without delay—which is good news indeed—but it must not be supposed that further sums (in addition to the first £500,000 (?)) will not be called for in the near future as matters develop. For the present, it was desired by General Sykes that not a penny of public money more than was absolutely necessary should be locked away. An entirely new public department can have few more difficult problems to solve than that of its estimates for expenditure, and, having no precedent to go upon, and, perhaps, no clear and final view of the limits of development it may reach, it will undoubtedly draw from its critics charges both of extravagance and niggardliness. That seems to be a fair statement of the position, and we welcome it as such, in the belief that it represents the official point of view.

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The Matter of Organisation

We next come to the question of the organisation of civilian flying, so far as the Department is concerned. It is stated definitely that flying is to be divided under two heads, of which one will be State flying and the other commercial aviation. Under the first will be placed all work that is in any way connected with the three Services, with the Customs and with the Police. Under the second

will be grouped all other forms of flying. As flying develops, so will the activities of the Ministry. When the Post Office decides that the time has come for the delivery of mails by aircraft it will approach the Ministry, and tenders will be asked for. The selection of the machines will be made and the service will be run by the State. In the meantime, if the Ministry is unable to produce from elsewhere machines and pilots for the work required, it will be possible to draw on the Royal Air Force; but that is a consideration only to be entertained while the supply of commercial machines is limited. We are glad to have this last assurance, which means more than at first meets the eye.

Experiment and Research

It is intended that a sum of £2,000,000 shall be devoted to the purposes of experiment and research. This money will not be devoted entirely to Government work, but it is to be used also for the assistance and encouragement of the manufacturer, who, while he has improvements to perfect and test, may not have the necessary capital behind him, and is thus hindered from helping the State and the industry. A considerable amount of ground with aerodromes is being acquired for this purpose, and matters are being so arranged that the experimenter, while he has every facility at his disposal, has also a definite guarantee of secrecy.

Again this is good news. It may be possible, in the future, to definitely separate the funds to be allocated for Government and private research and experiment, respectively. Certainly it would be desirable, since the money being at the disposal of the Department it is only reasonable to suppose that where the sum available is in a single unit, so to say, the whole of it might easily be expended on Government work, leaving nothing at all for the encouragement of private enterprise. We do not say it would necessarily be so in fact, but the contingency is one that cannot be ignored. That sort of thing has happened before, and it would be as well to guard against it in the future if that is possible, as we believe it is.

As to the facilities to be provided, these are already partially in being. Aerodromes have been acquired at Orfordness, Roehampton, Farnborough, and other places, and are to be grouped in accordance with the work to be done at each. Some will be experimental stations, while others will be flying schools. The purely Service aerodromes are being reduced to a minimum, for the reason that it is desired to have, for the purposes of control, only a few centres. The Air Ministry has apparently based its plans on the successful Admiralty policy of having a small number of shipbuilding centres at Portsmouth, Chatham and Devonport. Training depôt stations are, in future, to be known as training depôt wings, with three squadrons per wing, each having its own definite establishment of *personnel*. In each station there will be available accommodation for civil use, to be leased at rates already fixed. There, too, will be installed meteorological bureaux, signals, and wireless, to be at the disposal of both military and civil branches. Aerodromes the R.A.F. wishes to dispose of will be offered to civil firms, but it may be necessary to borrow them for special purposes, and, if that is done, a small maintenance party will be left at each. Assistance will be forthcoming for the erection of aerodromes near factories as may be required, and this will be done on the understanding that they are liable to be called upon for emergency landing places for all craft on similar conditions to those governing the leasing of Government stations.

The Ministry does not propose to have any pilots of its own. The pilots for State flying will be found by the Services, and those who fly machines for civil purposes will be provided by the firms supplying the machines. All pilots, however, before receiving a licence, will have undergone training with the Royal Air Force, and will, later, be called upon to take their place in the reserve of that Service, and will be liable to attend manœuvres.

An Objectionable Proviso

All this is eminently satisfactory until we come to the last. Assuming the article under discussion to be the reflection of official intentions, which is obviously the case, it is clear that what the Air Ministry intends is to keep alive a modified form of conscription of pilots. The granting of a licence to fly at all is to be made contingent on training with the R.A.F. and enrolment in the Reserve of Officers. In other words, civilian aviation is to be turned into a closed preserve for men who have been trained in military flying in a military school, and all pilots are to be made liable to military service. We do not hesitate to say that this is invidious to the last degree. Why not extend the principle to all applicants for motor driving licences, and decline to grant such licences unless the applicants have been trained at Grove Park, and are made liable to serve with mechanical transport? The one would certainly be as logical and just; or, rather, as illogical and unjust as the other.

Again, what about the civilian schools of flying which, as we have many times pointed out, were a strong tower of strength to the Army in the early days of the War? Are they to be finally and completely closed down and their owners compelled to accept work as instructors under the R.A.F., or to seek other fields of livelihood? We need not elaborate the point further, since we have spoken our mind with a fair amount of freedom on more than one previous occasion. All we would say now is that we appeal once more to the sense of justice and proportion of the Air Ministry in the matter of the civilian schools which have really deserved well of the country. Nor do we see why it should be necessary for the Ministry to burden itself with the business of licensing private civilian pilots—unless it be that the intention is to charge a fat fee for such licensing—when there is already an excellent machinery in existence in the Royal Aero Club, working through its association with the International Federation.

Difficulties to be Surmounted

It scarcely needs saying that there are many difficulties to be surmounted before commercial aviation can become an accomplished fact. The worst of these arise from fog, wind and weather. If it were possible to guarantee against these, the inauguration of commercial services would be an essentially simple matter. But it is not possible, nor can it be until the meteorological services are in thorough working order. At present these services are in a most

Major-General E. L. ELLINGTON, C.B., G.M.G., Director-General of Aircraft Production and Research, R.A.F.

unsettled state. The National Meteorological Service has sections which provide information for shipping and agriculturists. The Home Office and the Board of Trade make their own calls upon it, and now the Air Ministry is prepared with a stronger claim than any, so that a better method of co-ordination is clearly indicated and the suggestion is that a service should be established under the Ministry, with a guarantee that all claims upon it should be equally met. Moreover, the Ministry is undertaking to give instruction to all pilots and observers in meteorology and wireless telegraphy.

Accidents and Insurance

The machinery created during the War for the investigation of accidents is, apparently, to be continued in the interests of the public safety. Licensing and inspection of machines are already provided for, and the suitability of every aerodrome will be tested before it is allowed to be used. Then, in the matter of insurance, it is hoped that every State form of insurance can be avoided altogether. The proposal at the moment is that the whole matter should be taken over by Lloyd's, and that they will develop the business on the same lines as those along which marine insurance is effected. Lloyd's have already been in consultation with the Ministry on the subject, and the probability seems to be that a satisfactory plan will be drawn up, based on every new type of machine being tested and licensed by the Ministry, while the subsequent responsibility for models being to plan will rest with Lloyd's. In other words, the Ministry will approve the design, and thereafter machines, like ships, will have to be built under the supervision of Lloyd's surveyors. And an excellent plan, too, since it will be carried out with a minimum of vexation due to official interference with detail, while the public will be assured of the safety and suitability of the type through the weight of authority carried by such an institution as Lloyd's and the confidence universally reposed in its methods and thoroughness. On the whole, the programme outlined is one that will meet, generally speaking, with approval. It would be strange if there were not one or two points to criticise, but so far as we can discern at the moment the only one that need cause serious misgiving is that relating to the training and licensing of pilots. That is one that should be, and must be, opposed to the end. We do not want to see flying and its accessories become a monopoly of the Service, which is what the idea outlined by *The Times* amounts to. No amount of argument can give any other construction to it, and we are against it for that if for no weightier reasons.

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Not Charity, for Heaven's Sake!

There is a movement on foot for the establishment of Women's Auxiliary Force Home Clubs for the Royal Air Force and other services, of which Princess Arthur of Connaught is the patron. A moving appeal for funds is being made by the Committee, through the correspondence columns of *The Times*, in which the words "this charity" are used. Now, we have every sympathy for the objects for which funds are asked, but we have none with the foolishness which leads a body of distinguished ladies and gentlemen to describe them as falling under the head of charity. Nor can we imagine that the "Home Clubs" are likely to be popularised among those for whom they are intended by the implication that they are charitable organisations. On the contrary, we can imagine nothing better calculated to cause resentment among those who have been giving of their best for the country in its time of need, or to give birth to the resolution never to set foot in one of these "charity" clubs. The Committee is going quite the right way to work to stultify what is doubtless an admirable work in the interests of the Women's Services, and we consider it owes a public withdrawal of its unfortunate use of a thoroughly objectionable word.

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An Australian Government Prize

It is a sign of the times that the Australian Government has offered a prize of £10,000 for the first flight from Britain to Australia by a machine manned by Australians. According to the terms of the brief cabled announcement, "competitors are to make their own machines and arrangements." Surely, there is some mistake here? It cannot be seriously intended that the flight must be carried out in a home-made machine. We can understand perfectly well why the proviso that competitors must make their own arrangements, but their own machines! Obviously, there is some error, and the provision need not be taken seriously.

In view of the number of entrants coming forward to participate in the Atlantic flight, we imagine there will be no lack of entries for the Britain to Australia event, though the restriction to Australian crews naturally narrows the field very materially. However, Australia has contributed a substantial number of very fine flying men to the Services during the War, and we doubt not that many of them will cast an eye upon the possibilities opened up by this latest offer of their own Government. We shall await with considerable interest the publication of fuller details of the offer.

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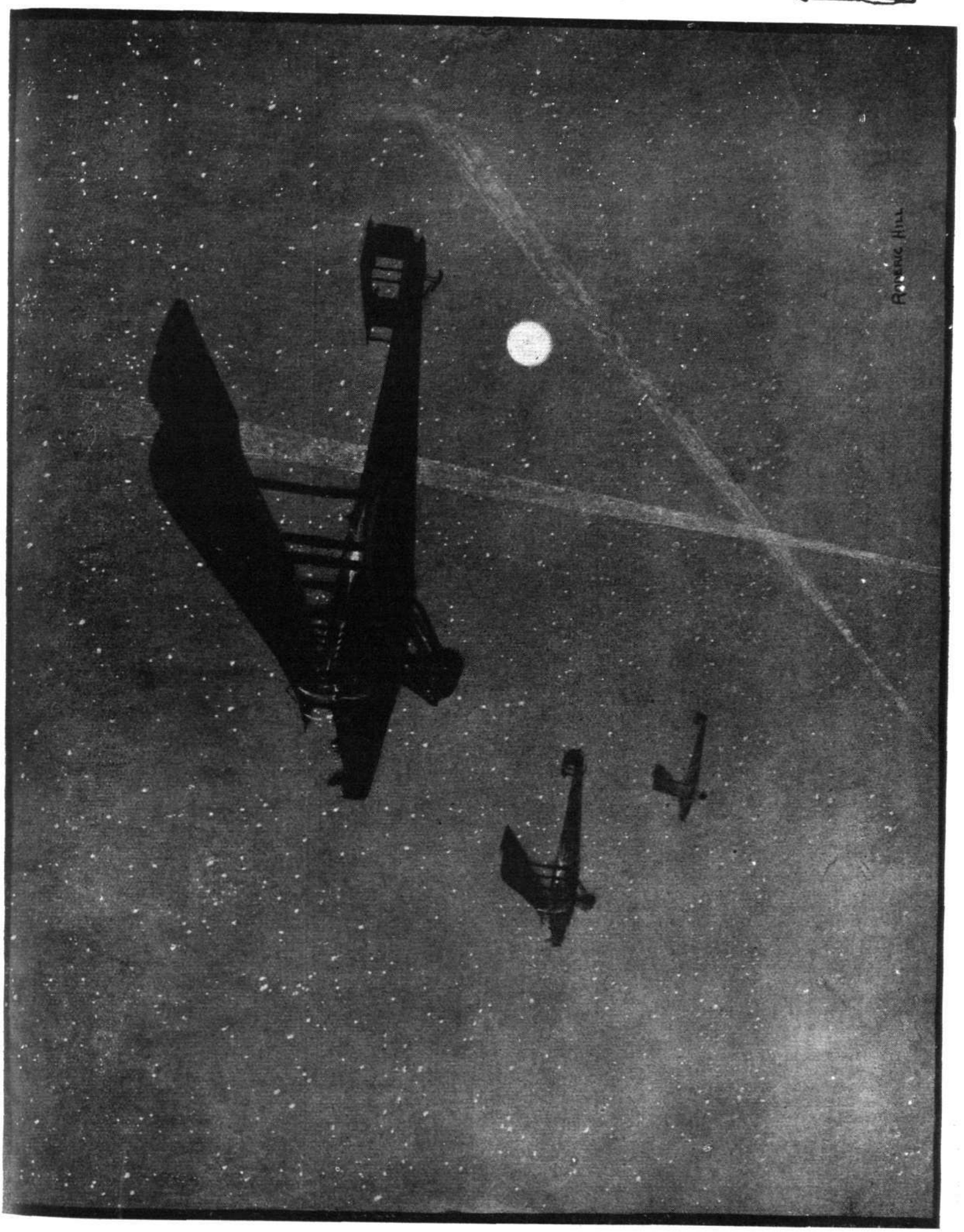
The Meteorology of the Atlantic Flight

The Meteorological Department of the Air Ministry is working all out on the arrangements for the Atlantic flight, which now looks like being an international race. A section, under Lieut. Clements, has been sent to St. John's, Newfoundland; another has been fitted up at the naval station in the Azores; and a third at Lisbon. A battleship is also to be stationed between the Azores and St. John's, which will co-operate in any official attempt by the Air Ministry or the American authorities, who have requested assistance, and are reciprocating. Major Gendle, chief of the R.A.F. Meteorological Bureau, interviewed by the *Daily Mail* on the subject of Mr. Hawker's attempt, said that the latter had arranged to let him know the moment he was ready. Then the Meteorological Bureau would closely watch its instruments on both sides of the Atlantic, and when the moment arrived would give the word to start. Once the machine has started, continuous wireless messages would be sent after it. Records over a number of years show that at this time there is a prevailing westerly wind of about thirty miles an hour on the surface which, 2,000 feet up, increases to forty-five miles an hour. In April, these velocities are decreased to twenty and forty miles an hour respectively.

Apparently, Mr. Hawker is not to have things all his own way. Already here are a number of other entries, and the position is interesting, not to say a little exciting.



And It Came To Pass

The following quotation from Ezekiel, Chapter I, seems curiously appropriate to the above picture:—Verse 23: "And under the firmament were their wings straight, the one toward the other: every one had two which covered on this side, and every one had two which covered on that side, their bodies." Verse 24: "And when they went I heard the noise of their wings like the noise of great waters, like the voice of the . . Almighty, a noise of tumult like the noise of an host: when they stood, they let down their wings."

FREE BALLOONING

A NOTABLE FACTOR IN THE ROYAL AIR FORCE

By Captain LANCE RUSHBROOKE, R.A.F.

THE public at large is apt to regard the spherical balloons which they see drifting slowly across the skies as relics of a stage already passed in the evolution of aeronautics.

Inevitably, the aeroplane, the seaplane and the airship, with their independent precision as means of aerial locomotion, have gone far toward eliminating the *operational* uses of free balloons. For such military purposes as reconnaissance, transmission of messages or supplies, or even photography, depending as they do absolutely upon favourable winds, free balloons, as a matter of fact, were never of first-rate practical value, though there are, of course, instances on record of their successful use.

During the American Civil War, for example, La Fontaine carried out a reconnaissance over hostile lines, and by the greatest good luck managed to get back to his own lines by rising to a much greater height and striking a contrary air current. During the siege of Paris balloons were used on several occasions to carry out messages, passengers and pigeons. (Jenson, the astronomer, escaped in this manner for the purpose of observing an eclipse from Tripoli, and, of course, the historic escape of Gambetta from the beleagured French capital will be recalled.) Again, during the siege of Ladysmith, a moored spherical balloon was used with considerable success for locating the Boer artillery; but this last and most valuable military operational use of the spherical balloon has now been usurped by the introduction of the improved kite-balloons—the now familiar sausages—which have the advantage of being far more stable than the spherical type, and are capable of being flown in a gale blowing at 40 miles per hour.

Yet the free balloon is far from being obsolete, nor is it likely to become so. It plays an important part in the training curriculum of the Royal Air Force, and every airship pilot and kite-balloon observer goes through a course at the R.A.F. free ballooning school.

The primary object of this course is to teach the best methods of navigating—and a good deal more is possible in this respect than would be supposed by the layman—and of landing a lighter-than-air craft.

It is really a provision against emergencies: one of those typical safeguards that the R.A.F. wisely insists upon, both in training and actual work. The course is included in order to equip the pilots and observers with the necessary confidence and experience of handling their craft, in the event of their breaking away from their moorings, in the case of kite-balloons, or of engine failure in the case of an airship.

If the wind be blowing *towards* the enemy's lines, the only course open to a K.B. observer whose balloon has broken loose is to take to his parachute. But, on the other hand, if the wind be blowing from the enemy's lines, the first duty of the observer is to salve his craft. And, as the learner soon discovers, considerable skill is called for in the navigation and proper landing on suitable ground of a balloon.

An airship which has been disabled, as the result of engine failure caused either by enemy fire or—rare occurrence—by irremediable mechanical breakdown, becomes in effect a free balloon. The necessity of ballooning knowledge is the more apparent in such a case because the larger part of the work of such craft is carried out oversea, where a parachute offers no solution. Here, again, the craft which has become in effect a free balloon must be navigated until the shore is reached, and a careful landing made, if the craft is not to be wrecked.

The R.A.F. free balloons used for this training purpose are of several sizes, carrying from one to eight passengers in the wicker basket suspended beneath.

Round the sides hang the bags of sand ballast. Anyone used to aeroplanes at first misses the numerous "gadgets" that surround one in the cockpit of a 'plane. The basket appears strangely bare. Only three instruments are carried in a balloon:—The altimeter, which registers the height above sea level; the statascope, the bubble of which indicates whether the balloon is ascending or descending, and—the prime essential—a compass.

The course of instruction normally consists of six flights. The officer under instruction makes his first four ascents entirely as a pupil. He watches the pilot in charge, keeps a careful log of each journey, and follows the course on the map. Practical map-reading, by the way, is another important subject which is taught by this course, and, travelling in a comparatively slow-moving balloon, the novice finds it much easier to pick up landmarks and follow his course than he would were he doing it for the first time in an aeroplane moving at from 70 to 100 m.p.h. or more.

On the fifth trip the pupil, though still under the superintendence of the pilot, handles the balloon himself. This is called his "pass-out" trip. Providing he has thoroughly satisfied the instructors as to his capability, he is then allowed to do his "solo." On this occasion he takes up the smallest size balloon, and manages the whole flight himself, navigating it, keeping the log, and landing it without assistance.

By navigation is implied the finding of the most suitable air currents—which vary at different altitudes—and keeping the balloon at that altitude, so securing the best speed and direction possible.

There is a very real fascination about ballooning—due in part, it may be, to the uncertainty as to one's final destination, owing to possible changes in the wind—that strongly appeals to the adventurous spirit of youth. Apart from its practical value, it is a unique form of sport, and it makes enthusiasts of all who are engaged in it.

On the occasion of my last flight we ascended in a medium-sized balloon with four passengers—the instructors, a pupil on his second trip, another on his "pass-out," an air-mechanic and myself.

One is hardly conscious of motion, as, on the command "Hands off," the little group of mechanics let go the lines, and the huge sphere of yellow fabric lifts the basket from the ground and soars upwards.

Rapidly the people on the ground grow smaller, and, as the wind takes control the green of the balloon ground beneath gives place to the roofs and chimneys of the neighbouring houses. Women look up from their work and children stop their play to give a cheery wave and shout a shrill farewell as we pass over the narrow streets. As we rise higher the wind freshens. Not that we can feel it, moving with it as we do. It is a feature of ballooning that, even when travelling at 50 m.p.h., the lash of wind on one's face, felt in an aeroplane, or even in a motor car, is never experienced. As a consequence, unless the balloon is fairly low and one is looking at the ground beneath, there is no sensation of speed.

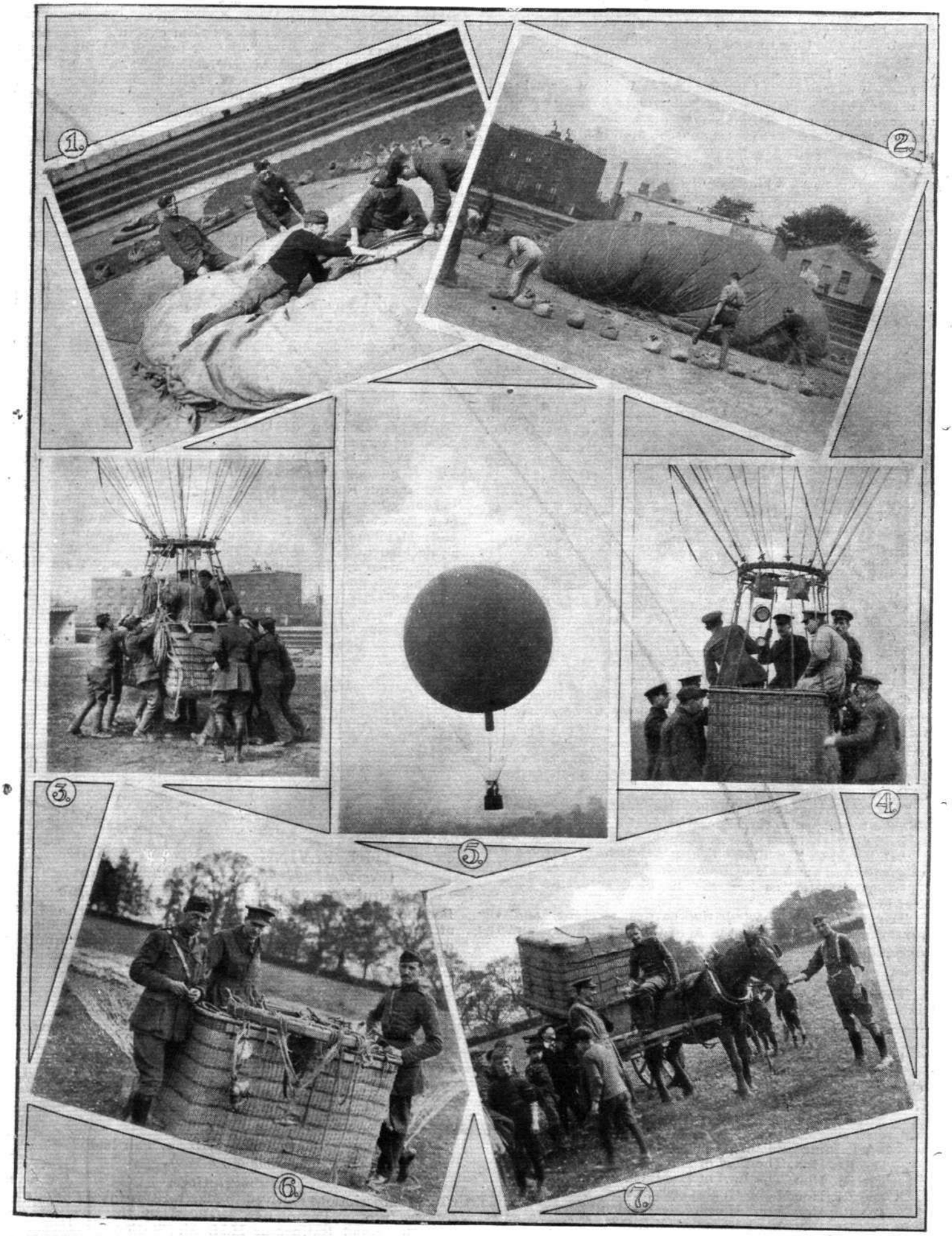
Down below is the winding Thames. We cross near a bridge. First the reservoirs are a prominent feature, and then the allotments on every little piece of spare ground. One notes a network of railway lines converging upon a large junction, and we pass 1,500 ft. over Willesden. Houses become less close-set, and presently their monotonous lines give place to a patchwork of fields and hedges as we pass over the outer suburbs. Right ahead, a notable landmark, we see Harrow-on-the-Hill. Leaving it on our left, we look down upon a floor of house roofs in crossing Wealdstone. We are travelling well now, and with a wind that we find most steady at between 1,000 and 1,500 ft.

As soon as we are clear of the houses the trail rope is thrown out. This is exactly 300 ft. long, and in descent acts as a check upon the altimeter, for that instrument registers only our height above sea-level. Thus, your altimeter may show 600 ft. when the end of your trail rope, almost on the ground, proves your actual height from that particular part of the earth to be little more than 300. Also, when landing, it checks too sudden a descent by acting as ballast as more of the weight of the heavy rope is taken up by the ground, and, thirdly, it makes it easier to take the exact course by compass.

It is strangely still and peaceful up here, a wonderful contrast with the roar and rush of an aeroplane. All the sounds of the countryside come floating up as we sail placidly overhead. The lowing of cattle, the song of birds, and the excited clucking of poultry as they scatter from the path of our approach, many hundreds of feet above them.

We are losing height a little, and the "pass-out," with his eye on the altimeter, throws over the contents of a bag of ballast. The sand falls slowly, and, tailing out in a yellow streak, is lost to view before it reaches the ground. The roar of a distant train marks our approach to a railway. Rivers, canals, roads, villages and towns float below us in a fascinating and multi-coloured panorama. In a balloon one has leisure to appreciate such details. I noticed with particular interest the yellow and russet brown circles formed by fallen leaves round every tree.

Then the rain came. As the weight of the water on the balloon increased we lost height rapidly. Bag after bag of ballast had to be emptied at irregular intervals. Again the



FREE BALLOONING AND THE R.A.F.—1. Adjusting the valve ; 2. Inflating the balloon ; 3. Ready to leave go ; 4. Basket showing the statoscope and altimeter ; 5. Leaving the ground ; 6. After the landing ; 7. Packing up ready to start for the station.

sun shone, and as the envelope dried and the gas expanded we rose rapidly. The statoscope bubble reversed. The altimeter needle climbed slowly from 500 ft., 1,000, 1,500, until it touched 4,500 ft., our maximum altitude on that trip. Fleecy clouds beneath now gave us a snow-white carpet. By this time we had passed through three counties—Hertfordshire, Bedfordshire and Northamptonshire—and were entering Leicestershire.

The sun had expanded the gas and had driven a good deal of it through the bottle-neck just above our heads—left open to prevent any risk of burst—and once more we began to sink at the rate of perhaps 200 ft. a minute. Our ballast was nearly finished, so we began to cast about us for a suitable landing ground. We were now passing houses in long straggling villages. Chimneys of black smoke proclaims it a colliery district. The trail rope is but just above the roofs. The smoke from the factory chimneys indicates that the ground wind has increased. It is gusty now and will make landing less easy.

The pilot takes charge. "Get ready the grapnel!" We pass the last house. He pulls the valve cord, and we lose height more rapidly. "Let go the grapnel!" The iron spike falls from the basket, and in a second or so we feel a jar as it bites the ground. The balloon pitches and then bounds forward again as the grapnel gives. The branches of a tree scrape the basket as we skim over it. Then once more the grapnel bites, and in that instant the pilot pulls the ripping cord, letting out the remaining gas through the opened panel. Rapidly we sink. The basket touches the ground. A gust of wind catches the envelope. A few convulsive bounds, and then the whole contrivance comes to rest.

We climb out, and whilst one goes off to fetch a horse and cart, the others proceed to detach the basket and roll up the envelope. A crowd soon collects, and willing hands help in the task.

. . . .

An hour or so later we and our balloon are in the train, on the way back to London, after an instructive and interesting flight.

THE ROYAL AERO CLUB OF THE U.K.

OFFICIAL NOTICES TO MEMBERS.

SPECIAL COMMITTEE MEETING

A SPECIAL MEETING of The Committee was held on Tuesday, the 18th inst., when there were present:—Brig.-Gen. Sir Capel Holden, K.C.B., F.R.S., in the Chair, Mr. Ernest C. Bucknall, Lieut.-Col. Spenser D. A. Grey, D.S.O., R.A.F., Lieut.-Col. F. K. McClean, Brig.-Gen. E. M. Maitland, D.S.O., R.A.F. and H. E. Perrin, Secretary.

Election of Members.—The following New Members were elected:—

Robert Brown.
Sec. Lieut. Cecil Richard Burns Clarke, R.A.F.
Capt. Richard Malcolm Ansell Edlundh, R.A.F.
Capt. John Yule de la Cour Elliott, R.A.F.
Capt. Walker Huggan, R.A.F.
Major Francis Henry Humphrys (Indian Political Service and R.A.F.).
Capt. Arthur Robert Windsor Stuart Clark Kennedy, R.A.F.
Cecil Vivian Moore.
Capt. John Potter (Highland Light Infantry).
Capt. John Arthur Yonge, R.A.F.
Capt. Ryder Young, R.A.F.

Council 1919.—Letter was read from Lord Hugh Cecil accepting the invitation of the Committee to be nominated to the Council of the Club.

Nominations to the Committee.—Nominations for election to the Committee were reported. Mr. J. Stewart Mallam and Mr. R. B. Tyler were appointed Scrutineers of the Committee Ballot.

Federation Aeronautique Internationale.—It was decided to suggest to the Federation that a Conference should be held at the earliest opportunity.

"Daily Mail" £10,000 Trans-Atlantic Flight.—Letter was read from the Air Ministry offering the services of Major A. Partridge, R.A.F., as the Official Observer of the Club in Newfoundland.

The Secretary reported the entries received, and the arrangements made with the Aero Club of America and the Aero Club of Canada.

ANNUAL GENERAL MEETING

The Annual General Meeting will be held at the Club Premises, 3, Clifford Street, London, W. 1, on Monday, March 31, 1919, at 6 o'clock.

AGENDA

1. To elect Vice-President and Council for the ensuing year.

The following are recommended by the Committee for election:—

Vice-President:
The Rt. Hon. Lord Northcliffe.

Council:
S.A.I. Prince Roland Bonaparte (President F.A.I.).
The Rt. Hon. The Earl of Hardwicke.
The Rt. Hon. The Earl of Londsale.
The Rt. Hon. Lord Hugh Cecil, M.P.
The Rt. Hon. Lord Howard de Walden.
The Rt. Hon. Lord Kinnaird, F.R.G.S.
The Rt. Hon. Lord Montagu of Beaulieu.
Admiral of the Fleet the Rt. Hon. Sir Edward Seymour, P.C., G.C.B., O.M., G.C.V.O.
Admiral the Hon. Sir Edmund Fremantle, G.C.B., C.M.G.
Admiral Sir David Beatty, G.C.B., G.C.V.O., D.S.O.
Count Henry de La Vaulx (Vice-President Aero Club de France).
Sir David Salomons, Bart.
Sir Norman Lockyer, K.C.B., F.R.S.
Professor Sir William Crookes, O.M.
The Rt. Hon. Rev. Bishop Welldon.
Martin Dale.
Henry Deutsch de la Meurthe (President Aero Club de France).
Professor A. K. Huntington.

2. To announce result of Ballot for Committee.
3. To alter Rule 50 as follows:—

The Subscription for Members elected on or after the 31st day of May, 1919, shall be £7 7s. per annum and for Lady Members £2 2s. per annum or such other sum as may be decided upon in General Meeting and the Entrance Fee £5 5s. or such other sum as the Committee may from time to time determine.

The Subscriptions for Members elected prior to the 31st day of May, 1919, shall continue to be £5 5s. per annum and for Lady Members £2 2s. per annum or such other sum as may be decided upon in General Meeting, and the Entrance Fee £2 2s.

"Daily Mail" £10,000 Trans-Atlantic Flight

The following Entries have been received:—

Entrant:	Pilot:
The Sopwith Aviation Co., Ltd. ..	Mr. H. G. Hawker.
Messrs. Short Bros.	Major J. C. P. Wood.
The Fairey Aviation Co.	Sydney Pickles (late Flight-Lieut., R.N.A.S.).
The Whitehead Aviation Co. ..	Capt. A. Payze.
Capt. Hugh Sundstedt	Capt. Hugh Sundstedt.

THE FLYING SERVICES FUND

(Registered under the War Charities Act, 1916)

Administered by the Royal Aero Club

For the benefit of *Officers, Non-Commissioned Officers and Men* of the ROYAL AIR FORCE who are incapacitated while on duty, and for the widows and dependants of those who are killed or die from injuries or illness contracted while on duty.

Honorary Treasurer:
The Right Hon. LORD KINNAIRD.

Committee:
Lieut.-Col. T. O'B. HUBBARD, M.C., R.A.F. (*Chairman*).
Mr. CHESTER FOX.
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FLIGHT

THE NAPIER LION AEROMOTOR

Twelve Cylinders, 450 h.p., and 30,500 ft. Altitude

FOLLOWING the above sensational performance of the Lion aeromotor on January 6, a few brief particulars of its leading characteristics, with an illustration that conveyed an excellent impression of the quality of its design, externally, appeared in these columns. These can now be supplemented by a detailed description that should be of no small interest to connoisseurs of aeromotor design—probably the highest expression of mechanical engineering.

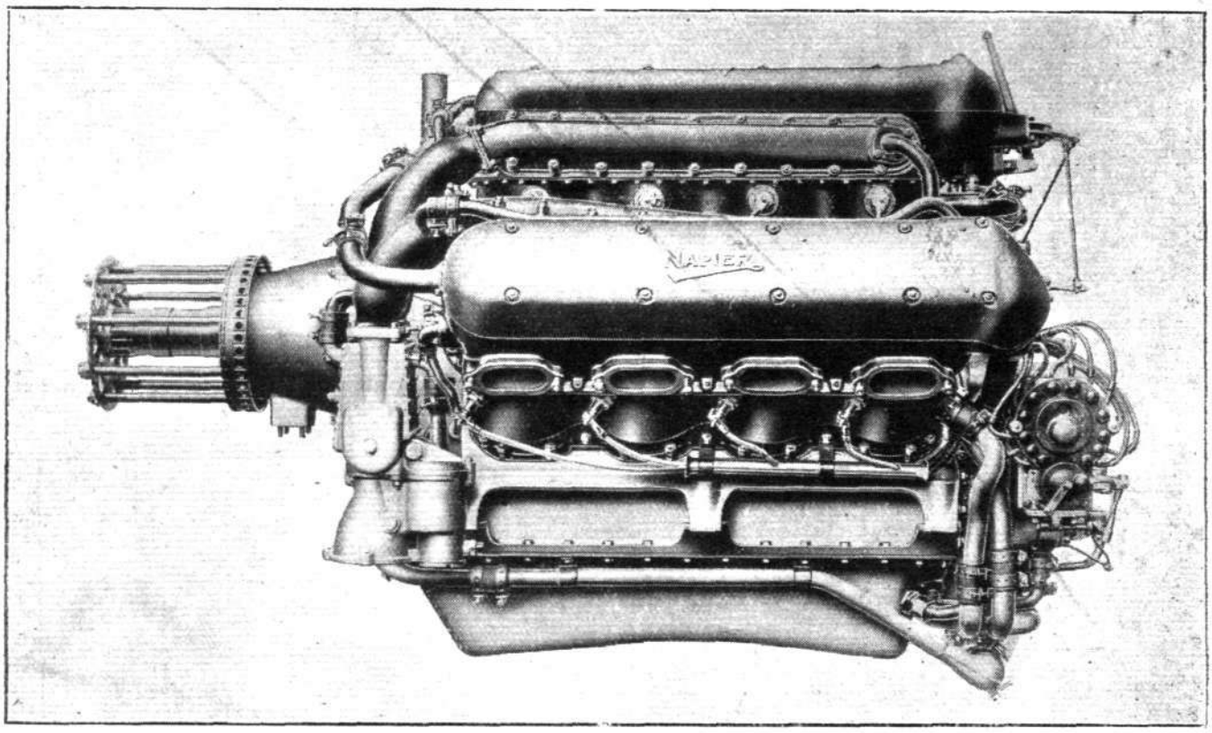
As will be seen, the Lion aeromotor consists in the mass of three groups or " banks " of four cylinders each, mounted " broad-arrow " fashion at that angle to one another which, in the four-stroke cycle, has been found the most appropriate for ignition with but two magnetos, in the requisite range of advance and retard. In type it is just on the short-stroke side, the bore being $5\frac{1}{2}$ ins., and the stroke $5\frac{1}{8}$ ins. : the normal speed in r.p.m. being such as to sustain best the approved normal propeller speed, as effected by the reduction gearing ; with a possible acceleration, so it is understood, above that normal, for the higher altitudes.

In the original serial issue, each group of four cylinders was water-jacketed, monoflux fashion, although each cylinder was formed then as now, as a unit machined from the solid steel forging. But now each cylinder is separately water-jacketed as well, the thin steel water-jackets being formed of sheet metal pressings, united in vertical welded seams back and front, and welded to cylinder flanges at the top and bottom of the water-spaces in a slightly downward tapering formation, the reason for which will be presently apparent. This construction not only eliminates gaskets and leak-rings, but also the adaptors and tapered wedge nuts for the sparking plug bosses of the former monoflux pattern ; these bosses being now not only screwed into the cylinders, but welded in place. It will be noticed that on the induction side, and on either side of the boss-insertions—in each group—horizontal water-connections or spouts are welded into the top of the jackets, in flats pressed therein ; and united with rubber hose-tubing and clips, so as to maintain a direct line water-inlet runway. On the exhaust side, at the bottom of the jackets, similar water-unions are likewise formed and united for a direct water outlet runway. But their lessened diameter being additional to the jacket taper, the object of keeping the cylinders warm and thus retaining greater thermal efficiency at all altitudes, is finally attained ; this being one of the details of design obviously helpful towards the low consumption of the Lion motor.

To bring the cylinder units as close as possible, flats or straights are machined on the foot-flanges, which are held down to the crank-chamber by an adequate number of studs, as well as by three pairs of dog yokes on either side, lapping on the adjacent flanges.

The most original feature of the Lion mass-construction, however, is firstly that the cylinders are not, as in most other models, formed as open barrels, but with crowns, through which four holes are machined for the insertion of the paired valve-seatings. Secondly, these crowns are machined flat so as to fit the underside of the mo obloc aluminium casting of the so-called " cylinder head," which is actually (*a*) a stiffening block for the whole construction, (*b*) a water-receptacle for the cooling, by direct convection, of the thin cylinder-crowns, (*c*) a vehicle for the gas passages, in common manifold on either side, and as a mount for the induction ; also (*d*) in its upper part, as a cradle for the mounting of the entire valve gear of each cylinder group, and as an oil-tight container when its cover is fitted.

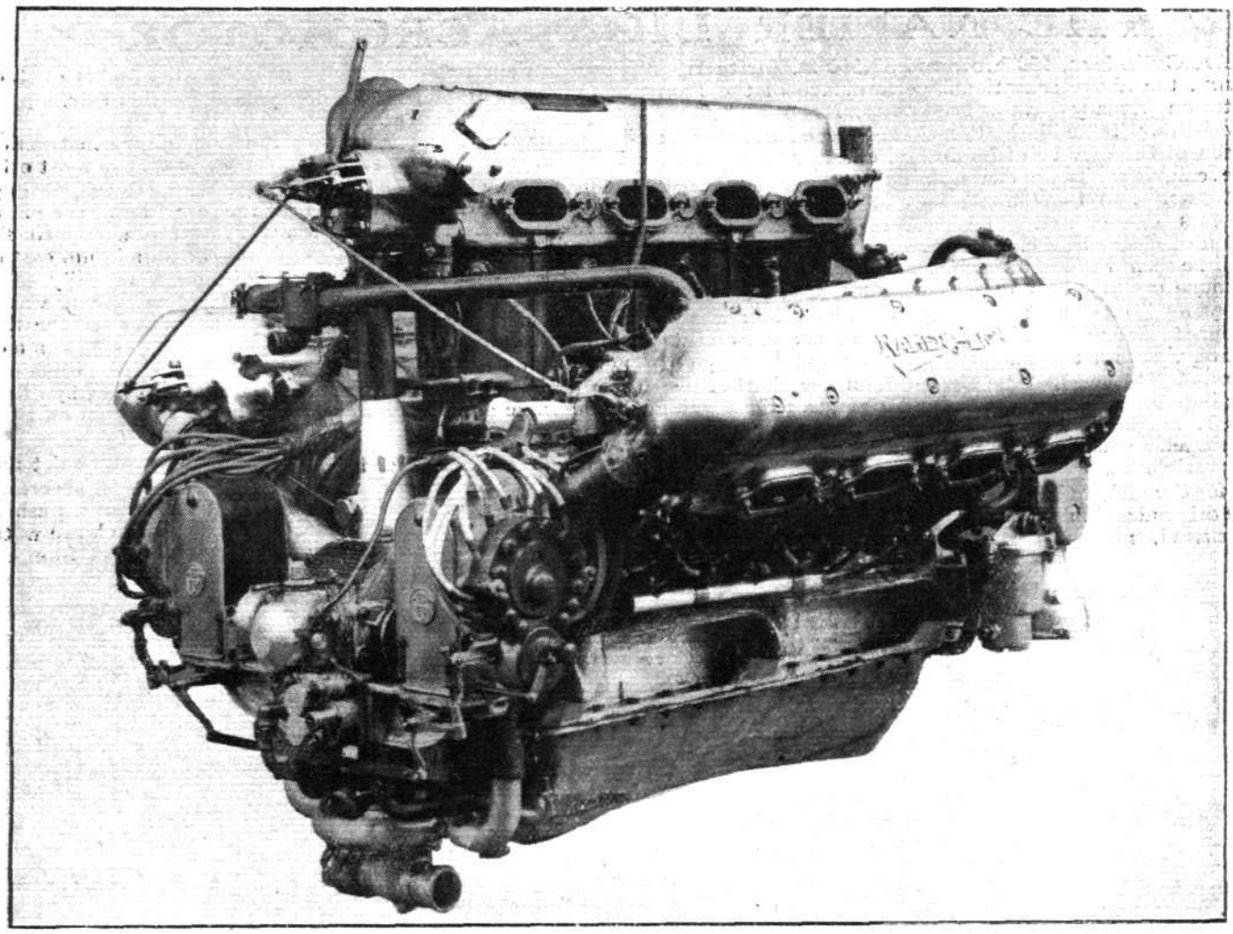
The head-block has, of course, a separate water inlet and outlet, the connection in the former case varying according to whether the motor is to be used as a tractor or a pusher. For a tractor both cylinder jackets and head-block are water fed from a small two-way union casting aft, direct from the pump inlet connection, the outlets for both being in front ; but for a pusher, the feed is first through the inlet-runway of the cylinders, then through a union-casting into the front of the head-block, and then out to the radiator through a pipe bolted to the flange at the rear-end of the head. In other words, the circulation is in parallel for the tractor and in series for the pusher.



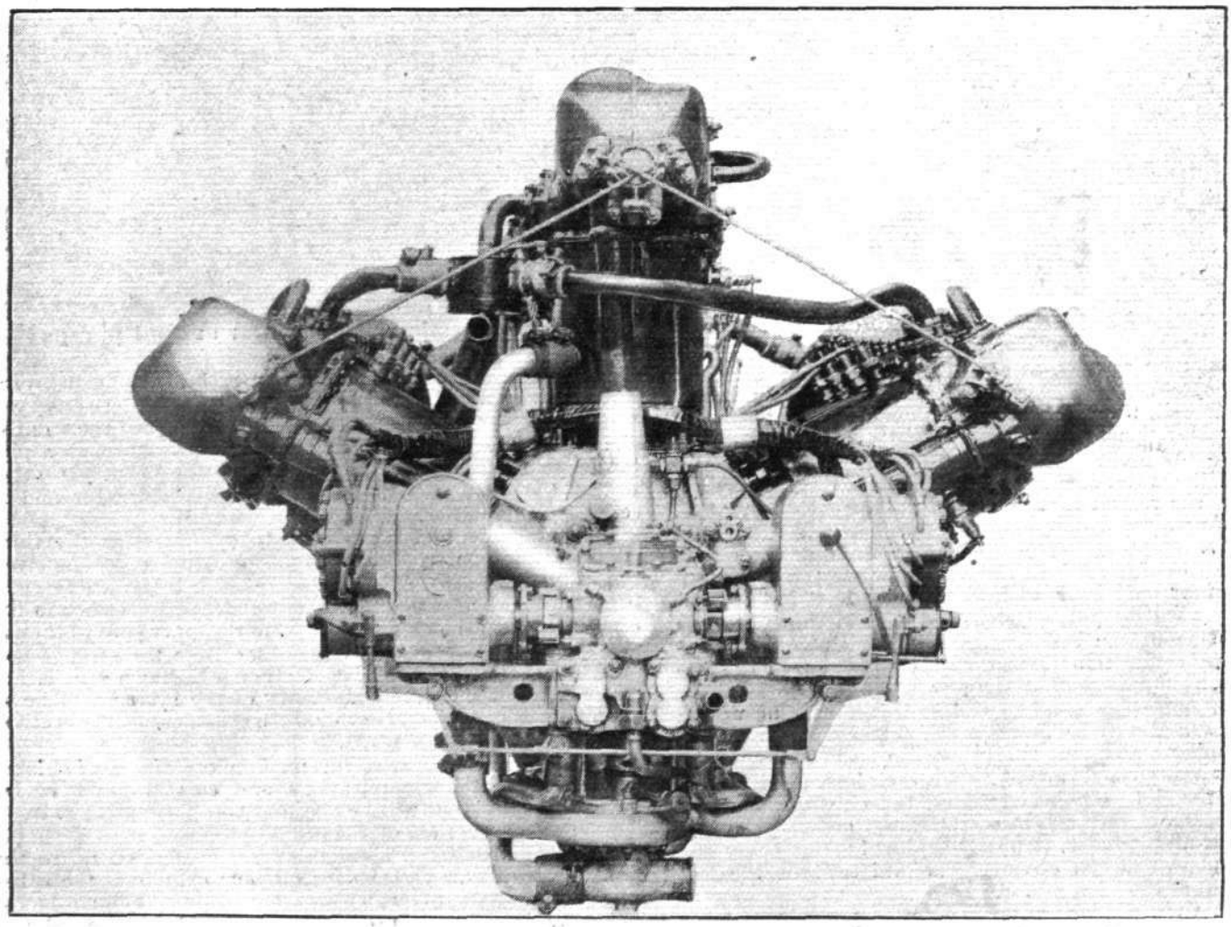
Side view of Napier " Lion " aero engine, showing the run of connections from water and oil pumps

For attachment of head-block to cylinders, as the third point of this construction, instead of struts or colonnettes, the valve seatings, which are shouldered heavily, are screwed from within the cylinders—as open nuts, so to say—into the base of the head-block ; thus to form the inner ends of the gas passages, as unions, and at the same time the strongest of attachments, 16 in all. The method of screwing in is not material ; but the simple ingenuity of the system will be as patent to all connoisseurs of motor-mechanics, as its effectiveness is—as and when fitted.

Those who have reviewed, much more those who have wrestled with the complications and encumbrances of induction manifolding will be the first to appreciate Mr. A. J. Rowledge's reduction of the whole proposition to a simple trough-shaped tapered aluminium casting, bolted up to the common induction passage for all four cylinders, the other longitudinal half of which is formed in the head-block. This practice, though previously employed for the exhaust of smaller motors, is new for induction ; and both theoretically



The Napier "Lion" aero engine, three-quarter view of rear end, showing all valve-gear-drives, magnetos, pumps beneath and starter-controls above.



Rear view of Napier "Lion" aero engine. Note, on left-hand side of middle group, the equaliser and mixture distributer and connections to the other groups, for use with the starting-gear.

and practically is better than a tubular formation integral with the head casting, as promoting the cleaner coring and accurate water-wall thicknesses essential in so powerful an aeromotor. Its taper is further purposeful, to increase the gas velocity and consequent full charging to the rear cylinders; not so well achieved even by the American endless hoop or shorehaul induction with its encumbrance of end-unions.

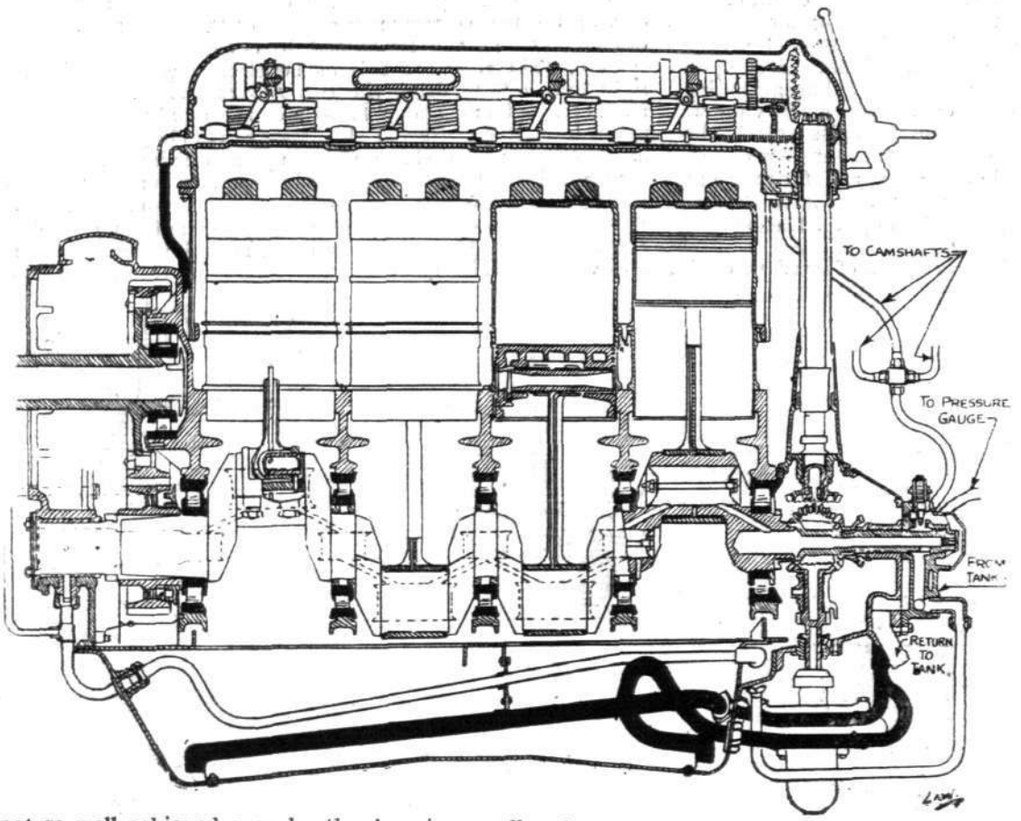
In this case the connection forward—for the right hand and vertical group, looking forward—is by two induction trunks, hot water jacketed from the head-blocks, with serial water connections to the jacketing of an N.S.2 duplex Claudel-Hobson carburettor; a similar induction-lead construction to a single N.S.1 carburettor of the same make, serving for the left-hand group. In all three, the water leads are returned to one or other of the water pump inlets.

As to the carburettor control, suffice it to say that since forced induction for high altitudes is inappropriate, if not impossible in such a motor-design generally, the simpler—and only—alternative of petrol diminution is employed, and is effected by a certain method which more nearly equalises the pressures in the mixing and float-chambers.

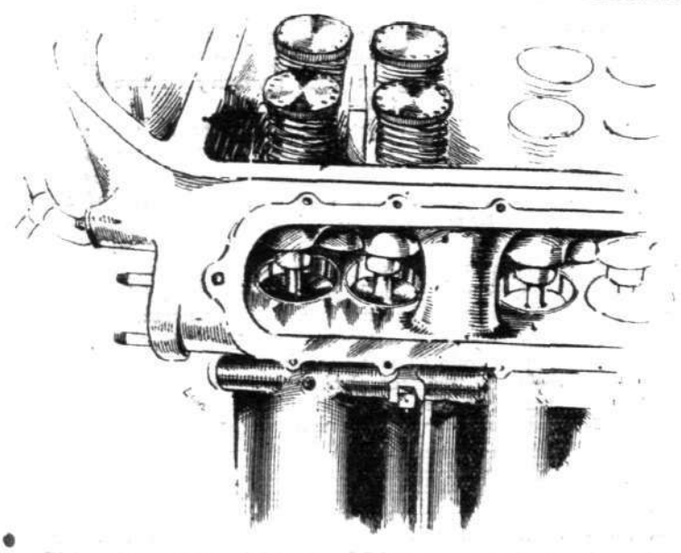
A further feature of the induction is the gas starter. Reference to the illustrations will show a connection set into the rear end of each induction passage cover. Each of these runs to the wall of a four-way distribution and equalising cock. The inner drum of this device is so slotted, firstly, that it opens to each of the three induction connections in turn, while constantly open from the fourth connection; and secondly, so that, in the fourth or equalising position of the control lever, it gives free communication between the three induction connections, while closing off the fourth connection from the charging apparatus.

This last is a pipe running to a two-way cock set in the interconnections of a special vaporiser and air pump device, which is mounted independently of the motor, in any convenient position in the cockpit. In one position this cock closes off the vaporiser and gives direct communication between the air-pump and distributer, so that each group of cylinders can be scavenged out in turn, while in the other position it cuts off that communication, and turning the whole of the air from the pump through the vaporiser, likewise passes the resulting explosive mixture from the latter to the distributer; so that each group of cylinders in turn can be charged with mixture impelled by the pump, when the motor may be fired by the hand-starting magneto.

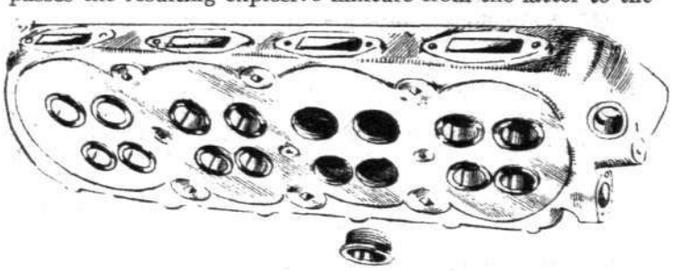
The air-pump is of the ordinary hand-operated double-acting type, with leather faced, spring-controlled inlet and outlet valves at each end; while the atomiser consists essentially of a carburettor-construction of the concentric float type, having a horizontal spray jet beneath its choke tube, to which the petrol supply is controlled by a quadrant-set needle-valve. Above the choke-tube is an inverted cone-shaped mixing chamber containing four umbrella-like gauze-



General arrangement sectional elevation of middle group of Lion motor showing lubrication system. The return or scavenging leads from the dry-sump ends are shown in black.



Side-view of head-block of Lion motor, induction side, with omnibus plate removed. Note the valve-seatings, screwed in to form open unions attaching the cylinder crowns to the head-block. Above: The valves paired in sets of four for each cylinder. Below: The continuous-line water-inlet runway formed by the clip-attached rubber tube unions. At the end the attaching point of the two-way union casting to the head jacketing.



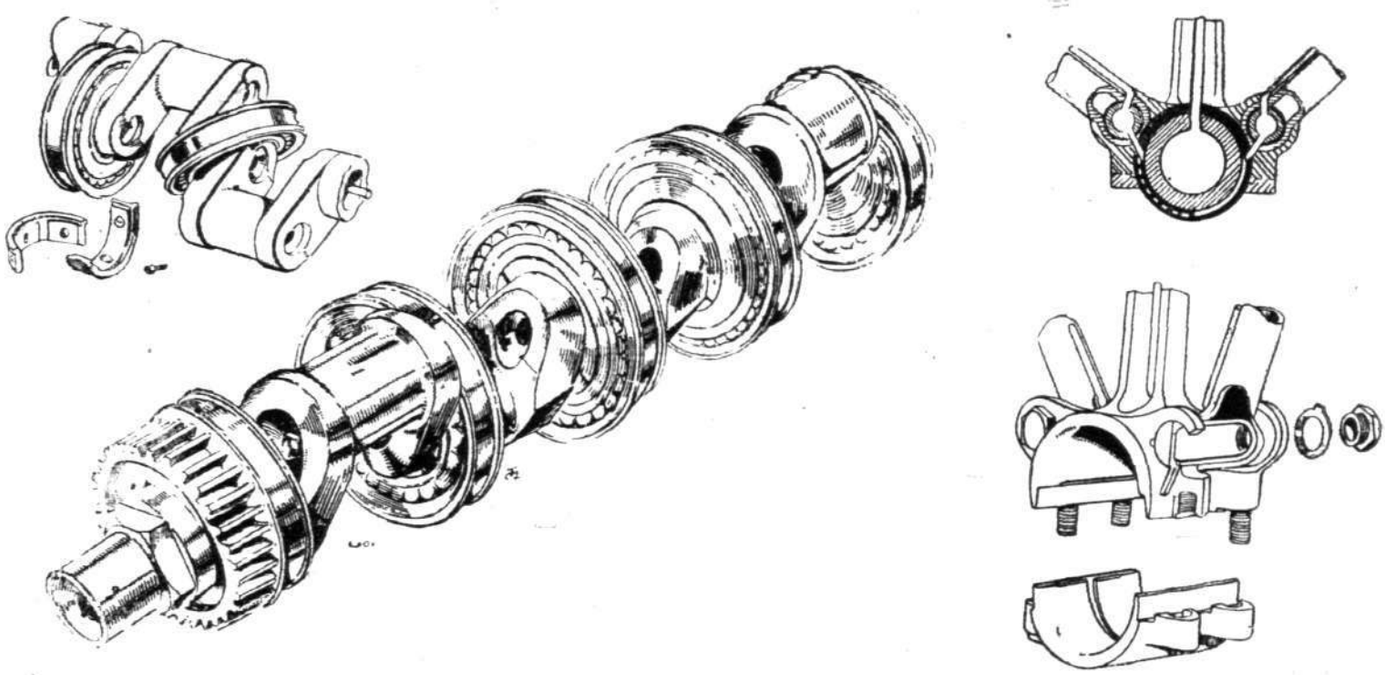
View of underside of head-block, showing metal-to-metal fit with cylinder crowns, and valve-seating attachment of crowns to head-block.

screens of varying mesh, mounted one above another. In this way all the heavier constituents of the petrol are caught and drained back to the tank or a waste-pipe; and the whole atomiser, except the needle-valve control quadrant, is contained in a pot-like jacket, which may be heated with exhaust gases or hot water.

As for the exhaust, the single outlets from each cylinder are given any kind of manifold that suits the installation.

Coming now to the valve gear, this consists for each group, of two hollow camshafts, the cams of which act direct upon the adjustable tappet-heads of the valves; one shaft actuating the two inlets and the other the two exhausts of each cylinder. They are mounted in bronze bearings, in five cross webs in the cradle part of the head-block. One shaft is spur-gear driven off the other, in all three sets. Looking forward, for the right and left groups it is the inlet camshaft that is so driven, inwardly of the V, while in the vertical group it is the exhaust camshaft.

The drive to the right and left groups is effected through



The Lion crankshaft fully assembled with all roller bearings and driving pinion of reduction-gear; showing also the bushes beneath the races of the larger intermediate bearings. Inset: Construction detail of Lion crankshaft; showing method of building up to roller-bearing inner races slipped over webs, with halved bushes keyed upon the journal in a driving fit under running race.

bevel gearing from vertical drive-shafts—which for constructional assembly and dismounting purposes are in two parts, sleeve-united—mounted in long bronze sleeve-bearings at the top, around the union-sleeves, and at the bottom, above their driving bevels; each being enclosed within a tubular sleeve and lower encasement which constitutes a return for the excess valve-gear lubrication. Naturally, with the camshafts laid equidistant from the longitudinal axis of the head-block, the drive-shafts are off-set from the cylinder axes of each group to an appropriate angle. Also, the centre one drives a tachometer, and the right-hand one a Remy distributor at half motor-speed; in both cases through skew-gearing located beneath the union-sleeves.

The valves, which are not interchangeable, the thickness of their stems differing, have wide hollow stems into which the tappet heads are screwed.

The distribution gearing, which is carried inside two castings bolted together, and to the back of the crank-chamber to form a detachable unit, is actually in two divisions. The first, that of the valve gear, consists of bevel gearing; the main driving bevel on the crankshaft engaging the drive-shaft bevels of the right and left hand groups, while a second bevel on the latter drive-shaft engages the drive-shaft bevel for the vertical group. This arrangement is manifestly necessary, as there would be no space for a third direct driven bevel among these smaller intermediate transmissions, in a progressive reduction to half speed, as between the first main drive bevel and the final driven bevels on the camshaft.

The second part of the distribution is from a one-piece double reversed bevel keyed upon a hollow extension-shaft; which is dog clutched into slots milled on the hollow crankshaft end and attached thereto by an open threaded ring enclosing both dogs and crankshaft end. The forward one of the two bevels engages another on the head of a spindle, which, immediately below this drive, carries a skew gear driving the two corresponding gears of the oil pumps, and is dog-clutched at the lower end to engage the water-pump spindle. The rearward driving bevel engages bevel pinions, right and left, to drive the two A.V.12 B.T.H. 12-cylinder magnetos—at one and a half-times the crankshaft speed—through vernier-adjusted leaf-spring couplings from the intermediate pinion shafts to the magneto spindles.

So much for the essential mechanism and general arrangement of externals. The next interesting original feature of the Lion design—actually the most important component of the starting system—is the interconnected valve-relief control which enables the air-scouring and mixture-charging to

Above: Big-end lubrication detail. Right and left are the anchoring pins that cannot rotate, and thus as oil-cells receive lubricant from crank-pin bearing for distribution to gudgeon-pins by way of the outer tubes.

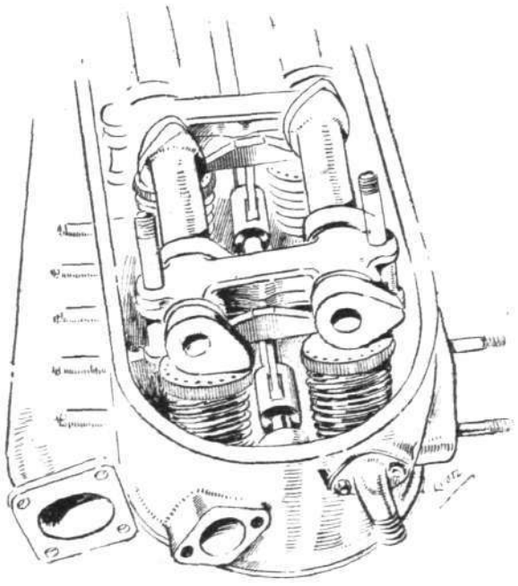
Below: Big-end construction detail. Note the substantial rooting of the side lugs clear of the base of the central master-rod. Also the method of pin attachment to prevent the pins rotating and the scarf-joint of the bearing cap or shoe.

be effected. This consists essentially of a set of T-shaped depressor-levers, four for each set of cylinders, which are anchored through lugs behind their shank-parts, to lugs beneath the camshaft bearings so that their T heads bear upon the tappet heads of the two forward valves of each cylinder; while the free feet of the shanks engage slots in a five-jointed spring-loaded pull-rod lying along the middle line of the valve-gear cradle at the bottom, with its rearward end brought through a bush in the cradle-end.

Now in the vertical group, this end of the rod carries a two-faced sheave-like collar, the inner face of which is engaged by the fork of a control-lever—anchored beneath to a bracket-arm on the head-block end—which, pulling out the rod, causes the T-pieces to depress the valves against their spring-pressure. At the same time the outer face of the collar engages the free arms of bell-cranks—also anchored to the head-block—the other arms of which are adjustably jointed to rods connected to other bell-cranks, likewise anchored to the right and left head-block ends, and engaging the ends of similar pull-rods actuating the depressors in those valve-gear cradles.

Recollections of the original Panhard auto-starting system—on the same charge-pumping principle generally—of later adaptations of similar systems for high-powered motors; air-bottle practice and so forth, might convey the impression that the charging in this instance was up to some degree

approaching normal pre-combustion pressure. For while it is obvious that the exhaust valves must be held open for the air-flushing, it is equally clear that while they remain open, no charging with mixture above atmospheric pressure can be effected, as any such charge would escape. Again, there is



Detail view of valve gear, front end, right hand cylinder group. On the left, omnibus induction plate. In front, water-inlet and outlet. Central, inlet camshaft on left, starting gear with T depressors and pull-rod in middle ; exhaust camshaft on right.

the equaliser, suggesting its own function, as apparently to establish an equal charge-*pressure* in all cylinders alike.

Both the impression and suggestion are all the more plausible that in a vertical or even a V-type, however mechanically balanced or roller-borne as to its crankshaft, some such arrangement, with charging at three atmospheres or so, would probably be essential.

Nevertheless—none of them happen to apply! The facts, on the contrary, in this case are, first, that apart from the complication of having—as the only practicable method in the circumstances—to *lift* the equaliser cut-off sleeve to some position in which it cut out all *four* connections, its equalising function does not apply at all for the operation of charging, but solely—and essentially, in default of such a total cut-out—for subsequent running. In brief, it acts as a junction-point for a kind of perpetual triplicate connection constituted by the three pipings, precisely like the far end of a three-way "shorehaul" induction. Secondly, the grouping of the cylinders being, not even at a V, but at the greater fanwise angle, the connecting-rod thrust angle upon the shaft is so much greater, and bears as from so many more radii at a time, that what with the reciprocatory-weight mechanical balance and the roller-borne crankshaft suspension in further aid, the series of slight explosion efforts of charges ignited at merely atmospheric pressure have been found sufficient for starting. Consequently to effect a start, it is merely necessary to hold back the control lever as far as it will go. Then the cylinder groups, one after another, are flushed with air : next—by the operation of the two-way cock—they are charged with mixture impelled from the pump, and merely filled with it ; the lever is let go and the valves closed ; and finally, the equaliser lever is set in the equalising position for all subsequent running-induction, and the motor is ready to be started on the hand-operated magneto.

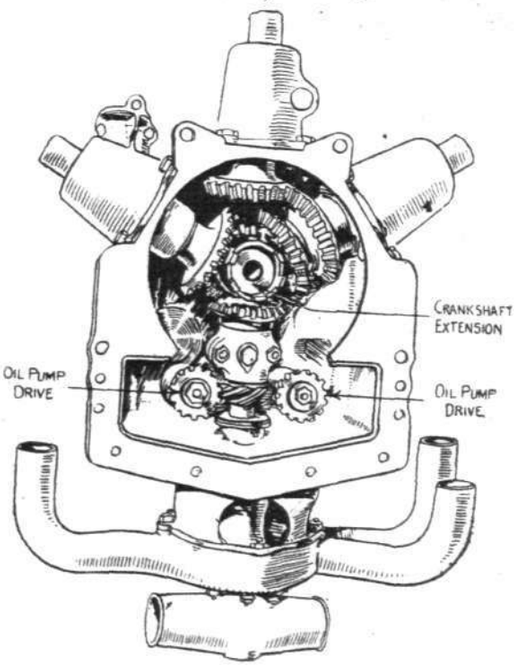
Internally, the chief features of the Lion motor are the crankshaft, with the special method of fitting roller bearings on the three intermediate journals ; the connecting rod fitting ; and the internal sump-scavenged lubrication for which all these parts and the valve-gear generally act as conduits ; the only external piping being the two rearward scavenging connections from the sump to the pump, an upward connection to the valve-gear, and a third one forward to the propeller reduction gear.

The crankshaft has its pins and journals hollowed, and closed again by bolt-connected, valve-like plugs to form oil-cells, and its webs drilled diagonally to form a continuous or serial-feed oil conduit from cell to cell. The problem of getting roller bearings on the intermediate journals has been solved—albeit at the compromise of paring the web-faces somewhat heavily, above and below—in what is understood to be the R.A.F. fashion of slipping the races of outsized bearings over the webs, and packing up to them with halved steel bushes, shouldered on one side and stopped on the other with a little butt-screw in the foot of the adjacent web ; one half of the bush being keyed to the journal to enable it to turn solid, and in a driving fit under the roller race. Theoretically the power-saving gain from the use of line-contact, all-but-frictionless bearings, is obviously enormous. Practically, owing to the diameter of the peripheral circle of the rollers, in this construction, the peripheral speed seems high. . . . . *Soit-elle brutale, ça marche!*

The end-journals of course, present no such difficulties, and owing to the reduction spur-gearing at the end, no thrust-races are needed ; the roller-bearings being simply housed in the crank-chamber ends ; their inner races threaded on the shaft ; the inner faces butted by the webs ; and their outer ones, held rearwardly by a keeper plate, and forward by the oil-thrower ring which is stud attached to the driving spur gear. The extremity of the crankshaft is mounted in a plain bearing housed in the metal of the reduction gear drum. Being hollow, it serves as the entry from beneath of the forward oil-pressure lead, as brought through the base-chamber from the other end ; and is merely closed with a removable plate to facilitate the flushing of the whole circulatory system with kerosene after every 50 hours flying.

The pistons, cast from a certain aluminum alloy, carry four rings on their very short trunks. These are chamfered and bored through beneath the two lower rings—which are scrapers—so as to return all lubricant in the slightest excess into the base-chamber. The gudgeon pins are hollow, and thus form the final oil-conduits to the cylinder walls. As they are pinned in the lugs with a taper ended split-pinned set-screw in each case, they do not oscillate in their steel bushes. Thus the oil-feed is necessarily intermittent, but only slightly so, owing to the slight angularity of the rod-head oscillation. On the other hand, it is frequently argued that the oil consumption is rather greater with a gudgeon pin thus fixed than in one that oscillates with the rod-head.

The connecting rod group in each case consists of a central I-sectioned—all-but sectioned—master-rod, the big end of which houses a bronze bearing, white-metal-lined,



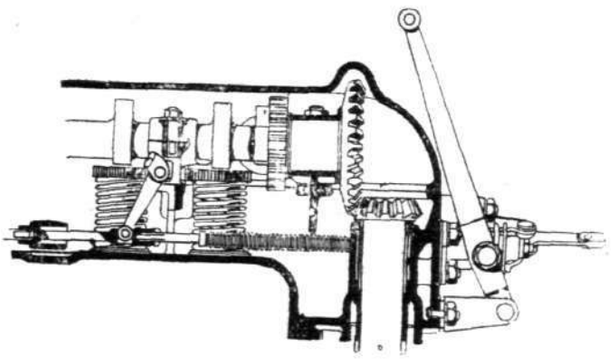
General arrangement of distribution gear for Lion motor.

and has its shoe—likewise lined—united in a scarf joint and attached by four-studs ; while the side-rods are tubular, and anchored to lugs on the big-end by hollow pins, so locked by end nuts that they cannot move endwise, and so held by snugs that they cannot rotate. Thus these pins constitute oil-cells, intermediate to the crank-pin oil-cells on the one hand, and the gudgeon pins on the other. Their oil supply, although direct enough through the bearings, by way of bored leads, is, of course, rendered intermittent by the crank-pin rotation. But their upward feed, like that of the master rod, is effected by external oil-pipes, returned against and into the rod-heads, and thence goes intermittently, into the gudgeon-pins.

Mechanically, the great distinction between this and similar connecting-rod unions for V, Y or " broad-arrow " type motors, is that the pin-anchorage is neither upon nor near the shank of the master-rod—which is thus not subjected to " necking " stresses—but is solely upon the mass of the big-end itself, into which the lugs are stoutly rooted.

As to the lubrication generally of the Lion motor, thanks to the appreciation of the extraordinary working conditions by Mr. A. J. Rowledge, it is indeed a true circulatory system. It would be no exaggeration to say that the motor to this extent is designed round its lubrication. It is possible that it might be further simplified mechanically in a detail or two ; albeit that proposition is not readily visible. And a further point to note is that the so-called oil-sump is not actually a sump at all, but, what is much better for " dry " lubrication, an oil-pan sunk towards the ends. Consequently in any case, whatever angle the motor may take, such oil as may be in the pan must go to the scavenger-pipe at one end or the other.

The oil pump itself consists of a body cast in two halves cored for the requisite oil passages, and bored to take six ntermeshing gears arranged in pairs, above and below, on

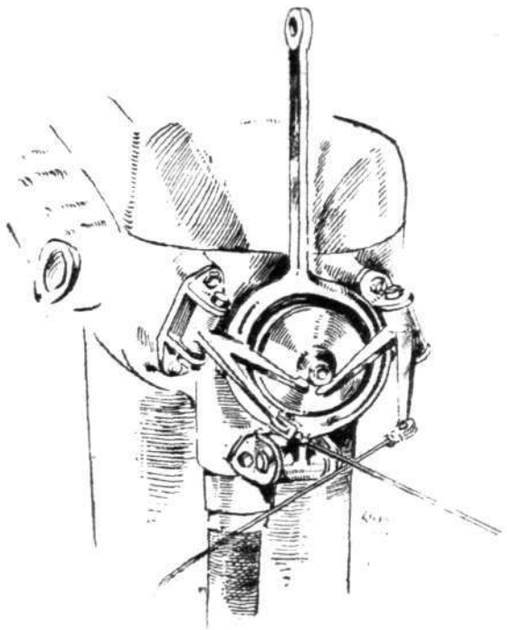


Detail of starting-g ear valve control. On the left T-shaped depressors bearing upon valve tappet-heads, actuated by spring-controlled rod beneath, pulled by lever on right. Behind lever note bell-cranks actuating similar mechanism for right and left-hand cylinder-groups.

three spindles. Two of these spindles, as previously stated, are driven by helical gears from the vertical oil pump driving spindle. The two lower gears in the front part of the body draw respectively from the forward and rear end of the sump, and deliver to the upper gears, which they drive. These deliver to the rear end of the crankshaft, thence to the adjustable relief valve, and by external tubing, to the pressure gauge, and camshafts ; while the pair in the rearward body—in tandem with the right-hand gears in the front one—draw from the tank and deliver to the front end of the crankshaft and the reduction-gear. The return-leads are, as already stated, down the valve-gear drive-shaft sleeves lubricating upon the distribution gear, and, by outside tubing, into the reduction gear.

For the rest, the reduction gearing is mounted in roller bearings, housed in the drum-like upward extension of the crank-chamber ; the propeller shaft, in addition, having double ball thrust bearings, housed inwardly of the outer roller bearing, so as to take all the thrust and allow the full benefit of the rolling-line contact of the latter to be obtained.

The final results of this design are that the entire motor, emp'y of lubricant, weighs only 1.79 lbs. per b.h.p. and only



Outer end-view of starting-gear control on middle cylinder group of Lion motor. The circular thrust-plate shown in the middle is mounted on the end of the pull-rod and is actuated upon its inner face. The outer face engages the bell-cranks for similar controls on the other groups, right and left.

a fraction over 2½ lbs. per b.h.p. in running order with the water in the jackets ; that the petrol consumption barely exceeds the b.h.p. hour half-pint, and the oil-consumption one gallon and a pint per hour for the whole.

These results seem to be all that matter to anybody not entitled to use a Lion motor. Admirable for those who are so fortunate as to get one, that is. Italian in its mass-simplicity, French in fineness of apposite detail, yet wholly British in conception and the harmonious blending of those other qualities with refined and faithful workmanship. So much is merely just and deliberate appreciation of what is coldly evident.

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The Transatlantic Flight

Another definite entry has been made for the *Daily Mail* transatlantic prize in the shape of a Short biplane fitted with a 375 h.p. Rolls-Royce engine, nominated by Messrs. Short Brothers. It is to be piloted by Major J. C. P. Wood, R.A.F., assisted by Capt. C. C. Wylie, R.A.F. Major Wood has seen a good deal of service as a long-distance bombing pilot, while Capt. Wylie, in addition to a considerable flying experience, was for two years engaged on destroyer work in the Atlantic. The machine will be a biplane—of military type—of 51 ft. 6 ins. span and 34 ft. 6 ins. overall length, weighing, loaded, about 8,000 lbs. The speed is estimated at 95 miles, and it is proposed to make a non-stop flight from St. John's to England. There is nothing unusual about the machine except that the petrol will be carried in a large torpedo-shaped tank under the *fuselage*. This has a quick emptying device which will give the tank sufficient buoyancy to keep the machine and its crew afloat for some hours in the event of a forced descent in mid-ocean.

Another definite entry is that of the Fairey two-seater seaplane, with 375 h.p. Rolls-Royce engine, entered by the Fairey Aviation Co., but the only particulars available are that the wings are of 46 ft. span, and fitted with variable camber.

It is also stated that a Martinsyde biplane is nearly ready to make the attempt. The machine, known as the Raymor, is fitted with a Falcon Rolls-Royce engine of 285 h.p., and has a span of 41 ft., while the overall length is 25 ft. Mr. F. Raynham is to be the pilot and Capt. C. W. F. Morgan, R.A.F., the navigator. Their cabins will be placed one behind the other. That for the navigator will have an adjustable roof, so that he can secure himself against the weather, and glazed windows. The whole of the forward part of the body is filled with an aluminium petrol tank that will hold 370 gallons of fuel, sufficient for a flight of 25 hours at an average of 100 m.p.h.

Meanwhile the United States Navy is hurrying on the arrangements for a flight across by Lieut.-Comdr. P. N. L. Bellenger on a N.C. 1 seaplane fitted with three 400 h.p. Liberty motors. It is doubtful if it will be ready to start before May or June. It is understood that the Air Ministry is hurrying on the preparations for an attempt by one of the " Felixstowe Fury " flying-boats, which would be navigated by Col. J. C. Porte, R.A.F. The attempt would be made from Newfoundland with stops at the Azores and possibly Lisbon.

Ulster's Aerodrome

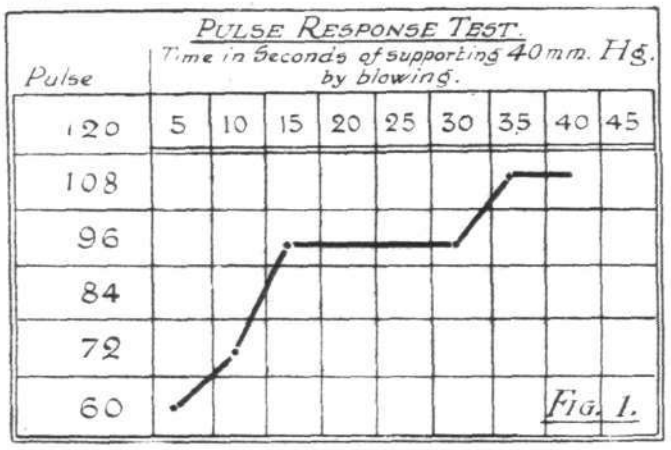
It is not unlikely that the Aldergrove Aerodrome, Co. Antrim, where the Handley-Page machines built by Messrs. Harland and Wolff are assembled and tested, will take its place in any aerial postal scheme between Ireland, Scotland and England. It may also be the station for the North of Ireland in connection with Transatlantic flights.

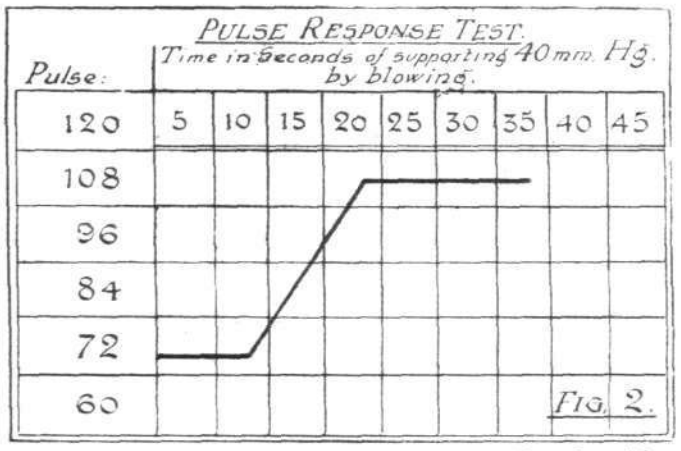
FLIGHT

OXYGEN AND THE TRANSATLANTIC FLIGHT

By Major T. S. RIPPON, R.A.F. Medical Service

ONE of the most important articles that should be carried on the machines attempting the flight across the Atlantic is an oxygen outfit for the pilot. It may be suggested that the extra weight is a handicap, but a consideration of the following facts should satisfy anyone of its value. (1) Oxygen increases the staying power and decreases the symptoms of fatigue when given to athletes. I have seen it given during boxing contests with excellent results. It was administered to a cross-Channel swimmer when he was exhausted, and he





THE USE OF OXYGEN.—Fig. 1 shows results of fatigue test by supporting 40 mm. Hg. by blowing. Before test. Fig. 2 shows results of same test after a flight. It will be seen that there is little or no difference.

was stimulated to renewed vitality and strength. (2) I have examined pilots after altitude flights with and without oxygen, and I can vouch for the fact that those pilots who did not use oxygen were profoundly fatigued, whilst those who used it were practically normal when they landed. The following figures demonstrate the accuracy of this statement. They show the physical condition of two officers before and after a flight using a liquid oxygen apparatus.

The test was absolutely successful in demonstrating that by the use of oxygen the pilot can be maintained at altitudes in a normal physical condition instead of being mentally sluggish and physically fatigued.

1. The examination of Major S. for respiratory fatigue with the mercury manometer was as follows: Before flight the expiratory force was 60 mm. Hg. After flight it was 65 mm. Hg. The pilot felt invigorated instead of tired.

2. The breath holding test gave 46 minutes before flight, 55 minutes after flight.

3. Fatigue test by supporting 40 mm. Hg. by blowing. (See chart.)

Fig. 1.—Before flight	40 secs.
Fig. 2.—After flight	35 secs.

Showing practically no difference.

Circulatory System.

1. *Pulse—*

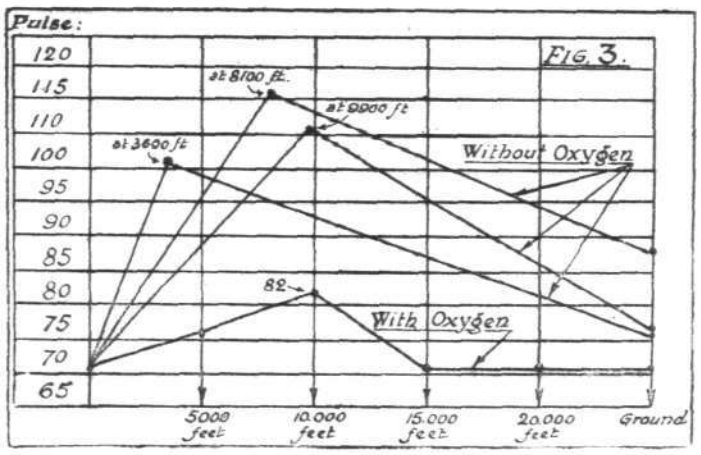
Before flight	70
At 5,000 ft.	75
At 10,000 ft.	82
At 15,000 ft.	70
At 20,000 ft.	70
After flight	70

Showing that at 20,000 ft. his condition was normal.

2. *Blood-pressure—*

	Before flight.	After flight.
Systolic	120 mm. Hg.	125 mm. Hg.
Diastolic ..	80 mm. Hg.	90 mm. Hg.
Pulse pressure ..	40 mm. Hg.	35 mm. Hg.

Condition improved rather than depressed.



THE USE OF OXYGEN.—Fig. 3: The upper curves in this graph are normal pulse curves during a flight without oxygen, while the lower curve shows Major S.'s pulse during a flight in which he used oxygen. It will be noticed that the increase is very small for the first 10,000 ft., after which it drops to normal again.

after altitude flights with oxygen, and in every case there was marked fatigue.

Amongst others, I examined the late Capt. B. C. Hucks, and the actual figures were as follows:—

	Before Flight.	After Flight.	Remarks.
Pulse.	84	96	—
Breath held	65	48	Fatigue.
Sustained 40 mm. mercury by blowing	54	35	Fatigue.

The Atlantic flight is a test for the endurance of the pilots as well as the engines, and the value of oxygen at even low altitudes on long flights, is of the greatest importance.

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The Ex-Kaiser's Escapes

IT is now disclosed that on two occasions the ex-Kaiser narrowly escaped destruction at the hands of the R.A.F., and on both occasions the attacks were made by the same squadron, No. 55.

On Christmas Eve, 1917, this squadron was carrying out one of its regular raids on Mannheim. Among the objectives was the railway station, which was hit and wrecked by several heavy bombs. Only 50 minutes before the ex-Kaiser and his staff, *en route* from the Verdun front to Berlin, had passed through the station.

The second escape took place as late as May 17, 1918. Between 4.35 and 4.50 p.m. 12 D.H. 4's from No. 55 Squadron attacked the main station and the railway triangle at Metz-Sablon.

Investigations made since the Armistice proved that the loss of life was very great. A "high general" was expected, a guard of honour had been paraded at the station, and a large crowd had assembled to witness the ceremony. The "high general"—no other than the ex-Kaiser—was stopped at Thionville, only 16 miles distant, and he and his suite hurriedly took cover.

THE SOCIETY OF BRITISH AIRCRAFT CONSTRUCTORS' DINNER AT THE SAVOY HOTEL ON MARCH 20

A BANQUET was held at the Savoy Hotel under the auspices of the Society of British Aircraft Constructors, Ltd., Mr. H. White Smith, C.B.E. (Chairman of the Society), in the Chair.

Among those who accepted invitations were the Right Hon. Winston Churchill, M.P., Brig.-Gen. J. E. B. Seely, the Lord Weir, Maj.-Gen. Sir F. H. Sykes, K.C.B., Maj.-Gen. Sir Godfrey Paine, K.C.B., Maj.-Gen. Sir W. S. Brancker, K.C.B., Rear-Admiral C. F. Lambert, Brig.-Gen. R. M. Groves, C.B., Brig.-Gen. W. Alexander, Brig.-Gen. R. Brooke Popham, Brig.-Gen. R. K. Bagnall-Wild, Brig.-Gen. J. G. Hearson, Brig.-Gen. E. M. Maitland, Sir Arthur Duckham, K.C.B., Sir Henry Fowler, Sir R. Glazebrook, Sir G. Stanley White, Sir Wm. Beardmore, Sir John Hunter, K.C.B., Sir W. A. Robinson, Rt. Hon. W. P. Schreiner, C.M.G., Sir Edward R. Bowring, Col. Sir C. C. Wakefield, Col. J. T. C. Moore-Brabazon, M.P., Col. C. L. Malone, Messrs. R. O. Cary, G. Holt Thomas, F. Handley Page, J. D. Siddeley, N. G. Gwynne, H. T. Vane, Claude Johnson, L. Coatalen, Capt. J. F. Fairbairn-Crawford, A. E. Berriman, G. E. Bradshaw, A. E. L. Charlton, A. J. Cattle, G. N. Handasyde.

The toast of "The King" having been honoured,

The Chairman, in proposing "The Royal Air Force," said in placing it first on our Toast list, it is not that we do not appreciate the great and glorious deeds of the Navy and the Army, but it is that in a gathering of the Aircraft industry our thoughts naturally turn to the Royal Air Force. Our Flying men in this country have come from the Colonies, from Canada, Australia, New Zealand, South Africa, India; and when you consider how these men, literally many of them only boys, have gone up day after day to fight alone in the clouds, with no-one to support them, entirely on their own, or they have gone up in twos, fighting in close comradeship, or they have gone off in the darkness of the night, in bombing expeditions against the enemy's country, we are filled with amazement and admiration. When we remember that their work has been carried out in every clime, in the torrid heat of Mesopotamia, of Palestine, of East Africa and the snow-clad hills of Bulgaria, to say nothing of the stormy Western front with the weather so uncertain and so difficult, day after day, they have gone up unhesitatingly to do their duty, and in this connection we cannot forget what our Naval Flying men have also done in patrolling our Coasts through fogs and mists over the lone North Sea. When we think of the way these men have gallantly laid down their lives we feel that no words of ours can adequately express our gratitude and that of our country for those splendid fellows. We constructors of aircraft are especially grateful to them, for it is to the Flying men we feel that much of the advance in design of aircraft has been due. We feel that it is due to them, in a great measure, that progress has been made, and we desire to-night to acknowledge it most whole-heartedly to them. We appreciate the privilege which has been ours to supply them with their Flying machines.

In proposing this toast one's thoughts naturally go back to the early days of the R.F.C. and the R.N.A.S., and we think of the good work done by Sir David Henderson, and the far-sighted views he took on many of the difficult questions in those early days, and we also remember the good work done by Commodore Sueter. You remember the difficulties that these men had, difficulties from a stingy Treasury, difficulties of obtaining the numbers of machines that were so urgently required, and we appreciate the great work that they have done. We think of the many other Officers who were associated with them, and who have given their services to build up what is now one united force. And we also remember the great work which has been done in the Field, in Flanders, by General Trenchard. The R.A.F. has, in these few short years, built up a glorious history and an imperishable memory; it has established its traditions as a Force of the highest courage, and we look forward to this great Service taking its part and we believe an increasingly great part in the defence of our Empire in the future.

Mr. Churchill's view—who has become the head of this great Force at a time of transition, we are glad to know—is that this Force should be a separate Service. We desire to express to him our appreciation of the great work which he did when head of the Admiralty and the great encouragement which he gave, in those early days, to the support and development of aviation. We remember and value the support he so freely gave to this work, as also afterwards as head of the Ministry of Munitions, and we feel sure that as head of the Air Council he will still more keenly have the interest of the great Service at heart, and that under his direction the Royal Air Force will retain its unique position in the defence of our great Empire.

The RT. HON. W. S. CHURCHILL, in reply, said: This formidable gathering marks the enormous progress made by the Aircraft industry during the War. When we look back to those early days to which our Chairman has referred, when we aimed at having 100 machines with which to fight against the potential enemy, it is a surprising experience to see how large our legions have grown in the process of beating Germany out of the air, as she has been beaten on the land and on the sea, and under the sea.

On the whole, looking back on the struggle, there is no doubt whatever that we produced a higher class of fighting airman, fighting being, or rather fighting angel in the air than any of the combatants whom we were compelled to encounter, and we also were capable of producing that being in larger numbers, drawn from more widely different classes of our race than any other country. Judged by the merit of the individual performance we have no cause to yield first place to any, but judged also by the area of the nation, by the numbers involved, we have an even greater cause for pride and satisfaction because the achievements of the Royal Air Force under these extraordinary circumstances show that the British nation is good all through and that from every class and under all the circumstances of the diversified accidents of our human fortune we have produced a race of fighting beings who exhibited the highest qualities of personal prowess and daring which, in all the history of the world, have ever been displayed among men.

The War is over. It has terminated in a victory so overwhelming that it far exceeds our fondest dreams, and yet that hardly satisfies some of our more moderate expectations. "Lest we forget" is an expression which forces itself upon the mind, but do not let us be disheartened by the temporary difficulties through which we are passing. We have made a tremendous effort, we have gained a tremendous result, and naturally there must be a period of reaction, mental and physical; there must be a trough between the waves. But the tide is going forward, the tide of British fortunes is going forward, and so far as the air is concerned, no doubt we have before us difficult years. We have years when the great War effort still leaves us exhausted and weakened, and when the new Peace development, the permanent development of the Royal Air Force has not yet risen to its full and steady maturity. We must all help each other in this difficult time to the best of our ability. On behalf of the R.A.F. and of the Air Ministry I can assure you that General Seely and I will do our utmost to help the Aircraft construction in this country.

We have obtained the services of General Sykes on the side of civil aviation. He will devote all his knowledge and all his influence to furthering the development of this great new condition of our daily life, which is bound to come into its own, be it this year or next year, or the year after. It is bound to come into its full and accepted fruition. And we have in General Trenchard, as Chief of the Air Staff, an Officer who will do everything in his power to facilitate from the military side the furtherance of the task on which General Sykes is occupied in his nights and days.

There are limits which we cannot transgress. There are limits to the amount of funds which Parliament can rightly be asked to vote; there are limits to the form and character of the help and assistance which we could give to the Aircraft industry, but within those limits we will do our very utmost in every way to liberate and stimulate the development of civil aviation in order to secure for the civilian and commercial aircraft of this country that same primacy which in the field of war we have, through the exertions of many here, succeeded indisputably in obtaining. I will express a most sincere wish that the British Aircraft industry will consolidate itself, will gather together all its strength to press forward, and to march forward on every reasonable and hopeful line of advance until it is quite clear that the conquest of the air in time of peace is sure and is as sure and as certain as the conquest of the Huns in the air was bound to be in time of War.

The CHAIRMAN: I should like to explain why we have asked Colonel Moore-Brabazon to take the important toast of "The Future of the Air." Colonel Moore-Brabazon

holds the British Aviator's Certificate No. 1. It seemed to us that we could not ask a better man than the man who started at the beginning to give us his views on the future of the air.

Colonel J. T. C. MOORE-BRABAZON, M.P., said : I am speaking here as representing the Royal Aero Club and in the absence of the Duke of Athol and General Sir Capel Holden, as your Chairman has told you I do represent, in a way, something of an historical character in aviation, for I would remind you that I have succeeded in solving a problem which at one time was thought to be impossible, and that was to cause a pig to fly. That is the most historical thing I can tell you ; also I would say that every day I have been made to feel that I am getting older and older, because in *The Times* you will see every day what happened 100 years ago, so you will see in FLIGHT what happened ten years ago. Only the other day I saw in that paper that I flew 150 yards. That particular occasion was very much impressed on my mind because it really occurred not through any fault of mine, but through a gust of wind, and when I reached the ground again and walked back to the hangar considerably alarmed, the taxi-driver who had brought me alarmed me still more by kissing me on both cheeks.

There is just one little point that I want to speak about to-night, and that is that if we are to look to the future, as the toast I have to propose asks us to do, before we do that we should just cast our minds back a little to the past, to the history of these last ten years. We have got to a position when we can, with confidence, say that we are right ahead of any other country in the world. And when we say that we have to remember that that did not happen by itself. It happened because of certain men in this country and certain men in this room to-night. I want to say this, that it is about time that this country said " Thank you " to those men. We have had some of our soldiers decorated and rightly so. We have received in the Air Force I think four K.C.Bs. and one Civil Servant has been decorated with us, because those men in a very able way knew how to direct the forces that were put into their hands, but we have to remember that there were other people who supplied the goods, who put them in their hands. You cannot make bricks without straw, and we have been given to use in the Air Force the very best machines in the world, and it is now the time I think that we, the public, should recognise the genius of the gentlemen who made the machines that gave us the victory.

In talking of the future of the air one is very liable to begin to tell fairy stories. I only give you an example. The other day General Seely made a most remarkable speech in the House of Commons and spoke of a machine he knew of that was going to do something remarkable. On that day in one of our prominent papers I saw, to my amazement, a picture of what was called an aeroplane. It looked, I must say, rather like a flying public-house, and it was described as the new aeroplane that will do 200 miles an hour. If there was one thing which was absolutely certain, it was the impossibility of its going 200 miles an hour.

Now I see many friends here to-night who have enormous confidence in aviation. They had such confidence ten years ago, even though now I think they are surprised at what has happened in the time. But just as they were confident in those days, so, in view of what we have done, we are deeply confident of the future of this great Service.

There is a peculiarity about Englishmen, which is that they like to be left alone, but circumstances over which we have no control have brought us under Government control of the Air Force. I think we may anyhow congratulate ourselves upon the men who had first to fill the responsible places to control us. First of all we have the Right Honourable gentleman, the Secretary of State for Air. It is a little bit difficult to speak after him in the beginning, but if I may make a remark in regard to him I would tell him that if by any chance he should happen to meet the Secretary of State for War I would ask him to tell him that we here believe that the one Service of the future and the one really attractive arm of England is the Air Service and nothing else.

And then we have General Seely, the Under-Secretary of State for Air. Not only is he particularly ornamental with his breast of many colours, but also I would say he is a man of singular intelligence. First of all let me say that it is very difficult to get £60,000 out of anybody, but he has managed to get that out of the House of Commons. And also let me pay another tribute to his great intelligence, and that is that he agreed to allow the Aircraft industry to design their own machines.

Now, Sir, I understand that the governing bodies of Aeronautics are going to use the great powers and the great ability of your Society in one of the sub-Commissions which are being formed for international use of aircraft. I do hope that on one of those sub-Committees not only will you use this Society, who are our hosts to-night, but the Government will also use a similar body, viz., the Royal Aero Club for which I speak because in the past I am sure you will agree with me that we have done useful work for aviation, as I hope they will do in the future.

Now then as to the future of aviation, do not let us think that the future lies in the hands of the Government to make or mar ; the future of Aeronautics in this country lies in our hands, and no others. It is for us to push ahead now that we have got right to the top, and never let anybody else pick us up.

Major-General the Right Hon. J. E. B. SEELY, replying, said : My first statement must be an apology that I, a civilian, should be in uniform, but the fact is that I arrived from Paris only half-an-hour ago, thanks to Colonel Robertson. When we were about three and a quarter miles from the Coast I looked at the speed indicator and observed we were going 100 miles an hour, I noticed that our height was 900 feet ; I did a hasty sum ; I said that is 300 yards, flying angle 1 in 8, let me see 2,400 ; can I swim the remaining two miles ? You will be glad to know that I was not asked to swim. The result was I arrived here coming by motor-car so late that I had not time to put on the appropriate costume of what Mr. Moore-Brabazon has called another place.

If the future of the air is to be for the world, and especially for the British Empire, what we hope it will be, there has got to be a combination of four things all working closely in harmony as a happy family. There has got to be wise direction and good laws ; there has got to be good laws for the air ; there has got to be the co-operation of the Royal Air Force and the pilots ; they are one and the same thing for the moment ; thirdly, we have got to have the co-operation of the people who make the aeroplanes, the workmen who make them ; and, fourthly—I am not giving them in the order of their importance—we have got to have the co-operation of the people who design them and make them.

With regard to direction I say nothing, as I am to some extent concerned, except that, in all sincerity, I do rejoice that my friend, Mr. Churchill, is at the head of the Air Service. He and I worked together at it in the early days, and we had a contest as to who should get the most money from the Treasury to which our friend there referred. I just won. Before the War I got rather more money, and I say, now it is all over, Mr. Churchill, that I am inclined to think that although I got a little more money from the present Prime Minister, you spent yours the best. You had the great good fortune that you found one or two geniuses. I will not name them, they are represented here, and you gave them a free hand, in the splendid way you have of giving people their chance. You did produce for the Royal Naval Air Service, which was a branch then of the unified Royal Flying Corps, now happily the Royal Air Force, the best possible machine it was possible to produce at the time, and I do not think that any one man in the administrative sphere has done so much for flying in this or any other country as Mr. Churchill. But there is another man whom I would describe as the founder of victory in the air. Just as Carnot was the organiser of victory in France 100 years ago, so Lord Weir was the organiser of victory in the air. Of course many others have been hard at work, have been doing their best, and doing it very well, but he just gripped the whole Army, brought all parties together and made a happy family, a real happy family.

As to wise laws, I will leave General Sykes to speak. We have both just come back from Paris, and it is a fortunate thing that at the meeting where the main principles were discussed, all those main principles were accepted by the representatives of the great nations there assembled. That is a great step forward. Sub-Committees are now considering the different details so as to carry out those main principles. Our Chairman to-night, Mr. White Smith, is the representative of this country, and a most able representative, on the Commercial Committee that is working out the details, and the most important details of that side of our business. But I would like to add this, that if we may say with satisfaction that the meeting, the day before yesterday, accepted all the great principles which we hoped to see accepted by them, it was to General Sykes that we owe it—that these main principles were laid down on wise, far-reaching lines in language which all could understand and in language which commended itself finally to the representatives of America, of France, of Japan and of Italy. I look forward next week to seeing the business completely settled, and if that happens, as I hope it may, it will be largely due to the foresight, to the energy and skill and devotion to duty of General Sykes.

On the third point, of course, we have got to have with us the workmen who make the aeroplanes. There is a great deal of thought just now about a strike. We who are concerned with aircraft cannot forget that, though we may feel disturbed and even angry at the prospect of so great a dislocation, these are the same people who worked so hard, so loyally, for such long hours, who put in such marvellous work to produce such wonderful machines. The same spirit that prompted them to do all that in time of War will no doubt carry us through our troubles in time of peace. I proclaim myself in this matter an optimist. I am sure the British character is not such as to spoil the great victory which we have won. Lastly, we have to make a complete happy family by bringing with us the designers and the makers of aeroplanes. Of design I would say this. We have got the mastery of the air, and we got it for several reasons. First and foremost because of the gallantry and daring of our pilots, but not less because we led in design. When the Germans produced an exceptionally fast machine, within a few months we had got a better, and so it went on like that, always rising a little higher than the German design, until finally we beat them at all classes of design for speed, for climbing power, for quickness of manœuvre, for length of journey, until ultimately at long last we beat them.

But, of course, there is one thing to be said, and an interesting thing to a gathering of the British Aircraft Manufacturers, an interesting thing in your presence, General Sykes, as Controller of Civil Aviation. Here we are talking of the future of the air which is a civilian future, and in the whole round world to-day there is not one civilian aeroplane; there is not one aeroplane designed for civilian purposes—not one. What a possibility for you all! Of course, in war we sought simply the overcoming of the enemy. We must seek safety in combat Safety in time of war was found by performance, by rapidity of manœuvre. In time of peace the quick climbing and quick turning were comparatively nothing. Comfort in war the pilot did not care for; who engaged in these desperate struggles would think of that?

If I may think aloud, I would say there is a great deal to be said for putting your passenger in front of your engines and propellers. Having flown about a great deal these last few weeks, I commend to you what was said to me by a man of great scientific eminence, that one of the principal difficulties in flying was the overcoming of the noise.

Another thing must be done. You must be able to land slower. There is so much mist in this country, and especially near big towns, and unless you get near big towns you do not get the advantage of speed, that you must be able to land more slowly. There are a hundred other things which of course leap to the mind, but I will not venture to bring them before you. In four years we have made advances unparalleled in history in any other sphere of human effort; if we advance in the future at even one-fourth that speed we can, indeed, make our travel a means to bring people and nations together more completely than anything else that has ever happened in the history of man.

Major-General Sir F. H. Sykes, K.C.B., C.M.G., responding, said: When Mr. Churchill asked me to try and undertake the tremendous work of the Control of Civil Aviation, I said that I thought one of the helps towards it would be believing that this new department should be and would be entirely civil, and that I should be a civilian. And I would just lay a little stress upon that, because in the Press there has been a little misunderstanding in that regard, in that this Department that I have the honour to try and support is purely civil. Its hopes, its aims, will in every case be to try and help on civil aviation. Service aviation will come alongside us with that *camaraderie* which General Seely and other speakers have mentioned as being an essential factor for the future.

But we have now passed from a period—a definite period—of fighting into a great big broad open sky, I hope, of peace. I believe that aviation, as I have said in Paris, and partly for that reason I think it has met with such cordial goodwill from the other nations, means more for that peace than almost any other factor can or will mean.

Of course there are a great many difficulties. It may be 500 years ago the seas were not charted, ships did not know where they were going to, what they were doing wandering about. After all, I mean, it is not very, very long ago, and yet people are pessimistic about the weather. When we have these wonderful modern machines and instruments that science is bringing to help and guide us, I personally am optimistic. I am sure it will come if we keep steady and firm. It will come slowly in some ways, in other ways very rapidly—at all events, in great and magnificent strides.

We have made a start, thanks mainly or largely to three or four factors—the industry, the pilots, the organisation, the training and the designers—and in War, the Treasury. The Treasury is a difficulty we come to in peace. The Treasury in war throws open its gates, and there is no doubt that it is very, very helpful in that way; but we must remember that in peace the Treasury must not cripple us. On the other hand, we must remember our responsibilities in regard to the money of the nation, and I know that nobody here will think that a spendthrift policy is the right one to pursue, for I do say, and hope and believe, that everybody here will agree with me in saying, that we want to know exactly how we spend whatever money is available.

Let me put this point. We have not yet reached peace definitely, but when that peace comes we shall have to have a review of all our financial efforts, whether Army, Navy, Civil, or whatever it is. Meantime this problem is so huge, is so incalculable, that all we can say is that we must think of it in the broadest possible lines and try to see what result we want to achieve. We must go step by step and say to the Treasury, We know this is right, and give us a sympathetic hearing if we have to come back and ask for more.

The way it is proposed to organise this Department is broadly into four or five branches. One for communications, to do with wireless signals, visual signals, telephone, telegraph, charts, maps and all those sort of things, survey work. Then, of course, there is meteorology, which we must put a big effort to. Then there is information. I want to try and collect information from all over the world and issue it to the industry, information which will help on the British industry in whatever direction it wants it in regard to information. The fourth branch I call the sort of business managership of the Department, which has to do with licensing, registration, records, aerodrome inspection, general assistance in all those directions. Another one has to do with the work which, for instance, has been going on in Paris, the broad views of international planning, rather on the lines of the Admiralty Planning Division, into which all the information from the other branches would come, and which would collate it on broad lines and be able to give assistance to the industry and to manage the Division as a whole on broad lines of policy, indicating Empire routes and so on, international relations.

We look upon this Department as, if I may say so, the unpaid partners of the British industry, and I hope you will view us in that way. To every form and firm of British industry to do with aviation we are a form of whatever it is put at, a half per cent., or whatever it is, of Government assistance to the industry as a whole, but our whole effort shall be put into help and goodwill to try and ease and oil and grease the wheels wherever it is wanted.

There is one announcement I want to make, and that is that this afternoon I had a wire from Mr. Hughes in Paris to say that his Government had agreed to the offer of a £10,000 prize to an Australian-manned machine which flies to Australia. If Australia takes that lead I hope all the other Dominions will follow. Then we shall be able to have great prizes hanging out the bait to all the ends of the world, and at all events it will help us.

Lord Weir, in proposing the British Aircraft Industry, said the aircraft industry affords one of the most striking examples of British energy and of British capacity in meeting the demands of our fighting services and our civilian services. Many great examples of wonderful development in technical progress and in industrial enterprise have been achieved during the War, but I doubt very much indeed whether there exists any example comparable to that of the aircraft industry be it in scope, rate of progress, or be it in the wealth of ingenuity, adaptability and enterprise devoted to the manufacture.

It must be remembered that, when one speaks of the aircraft industry, one does not think only of aeroplanes and of seaplanes, but of engine components, of various armaments of accessories, and of the thousand and one diverse industries associated with the aircraft industry. Putting it very baldly and very concisely, four years witnessed the growth of an industry of extreme complexity, of a highly technical character, and the growth by the original employment of not more than 1,500 people rising to the employment of over a quarter of a million employees.

Now that is the purely industrial attitude; the progress made on the technical side is more extraordinary. Speeds from 60 miles finally reached the standard of 150; flying weights increased from 1 to 12 tons, and engine weights were reduced from 5 lbs. per horse-power to 2 lbs.; the individual power unit was raised from 80 h.p. to the tune of approxi-

mately 700 h.p., and in multiple units up to over 3,000 h.p. In each and every item of that vast programme, a programme of effort and endeavour, British energy and capacity, however hardly pressed by other demands, confronted with difficulties at every turn, successfully accomplished the apparent impossible, with this result, that when their business was concluded, the aircraft industry of Great Britain could keep pace in its output of finished aircraft with the rate of development of the organisation which handled it against the enemy.

This performance has been due to a large number of factors. I believe that many of those have already been mentioned to-night, but I would place first among those factors the outstanding one of grim necessity; the job had to be done. History shows that Britain always responded to that call, and aircraft constructors were no exception to that rule.

The second factor is the existence at the beginning of the War of a small band of pioneer firms, those who provided the nucleus upon which the whole edifice was founded, without whose foresight and courage, in the early stages of the War, success would have been quite impossible. To those firms, a lasting and enduring tribute should be paid by the British people and by the Air Ministry. They were firms of individuals, who, before the War, became animated with a profound faith in the future of flying. They thought of flying in its military sense, without a hopeful feature early in the War, in fact faced with the certainty of a very large outlay and of a very problematic return had they devoted their time, their brains, and their enterprise to the thankless task of pioneering a scientific novelty against the apathy, scorn and, in many cases, often ridicule. To them the debt that we owe can only partially be repaid by the fullest degree of appreciation, by general practical arrangement, and recollection at all times and on all occasions of what they did and what they risked in fulfilling their ideals and in providing that strong backbone of enterprise and of sound technical ability which put their industry foremost against all competitors.

Another especial feature and factor has been the genius of the inventive capacity of our designers and of the technical staff of the Aircraft Constructors. To them we owe in a large measure the supremacy in the air, and to the great designers in particular we are not only indebted for high purpose achieved, but all the manufacturers and the entire industry are indebted for designs of machines for achieving this remarkable object.

And now the great struggle is over, the grim necessity of war no longer dominates our creations and our energies. The task for which this great industry was built up is now fulfilled to the greatest credit of everyone of you associated with aircraft production, and you now find yourselves faced with a set of difficulties quite as unique as those which obtained in your war experience. Personally I feel that you will face them with the same courage and with the same strength of purpose.

When you think of the industry as it stood on Armistice Day, when we consider the immediate future of military, civil and sporting aviation—because I believe that the sporting side will play a large part in the industry—you fully appreciate that you are to trim your sails to meet those altered conditions.

I am asked to propose prosperity to an industry that has an immediate future full of doubt and perplexity, but, gentlemen, with a final future of which there is no doubt, and in which there are limitless possibilities. We have seen how the necessities of war have produced this industry. A moment's thought shows that in its scale it is out of all proportion to its demand. Accordingly, to-night I will venture to plead on your behalf for the very fullest recognition by the Government, by the Air Ministry, that you are reasonably entitled to a special degree of consideration and to the most generous help and most generous support in the development of civil flying.

I have already publicly stated my views on the development of civil aviation and of the nature and of the character of the help which should be given, and from conversation which I have had with Mr. Churchill and General Seely which have been confirmed to-night, I feel rather sure you can rely on their very active support and prompt and decisive action.

However, there is one quality that I must ask you to exercise, and that is patience. The realisation of far-reaching new schemes, the bringing into being of new orders of things, and, above all, of new orders of ideas as to which we are almost overwhelmed just now, can never be achieved unless by the exercise of a degree of patience which appears strangely absent from all spheres of thought and activity connected with the problem of the moment. We are opposite in our ideas as to the rate, the justifiable rate, of acceleration and progress, and unfortunately this is coupled with a lack of recognition that the achievement of a War rate of progress is only possible coupled with a considerable degree of efficiency. We have to get back to a much more efficient rate of progress. Our thinking Departments are turning out more stuff than the manufacturing end can handle—in fact, to put it very bluntly, we are thinking too much and forgetting about hard work and industry.

Mr. White-Smith (the chairman) in responding said: I should like first of all to assure Lord Weir that no one is more grateful than the constructors for the work and the assistance that the Department of Aircraft Production has been to the industry. We know the valuable work which Lord Weir himself did as the Head of that Aircraft Production Department, and the work which has been carried on since so ably by Sir Arthur Duckham and by General Alexander, and also the valuable work in the technical Department which rendered us such great assistance under the able leadership of General Pitcher and General Weir.

The cessation of hostilities has brought to us a period of transition when we have to consider how we shall beat the sword into a plough-share. We have now to consider how we can reorganise our industry from a War industry to a peace basis. This question is one of the greatest importance. It is one which we were not able to consider while the War was on. We had no time to think of Peace, all we could think of then was how to win the War. We set about to achieve that end, and I think the remarks which have been made to-night have shown that we have done our part.

General Seely to-night, in his brilliant speech, has stimulated our faith, a faith which I may say has never flagged. We cannot flag because we had more difficult days in the past than exist at present, and I believe that the courage which we have had in the past will be with us still to face the difficult time which we have in front. But I think it is well to sound a note of warning, because a great many people, in their enthusiasm for aviation, are taking it as though commercial aviation were an achieved success. It is for us, as business men, to differentiate between what we imagine and what we believe to be possible, and what has already been achieved. For aviation to be a success, it must first of all be made to pay, and it can only be made to pay when the aircraft are so reliable as to produce absolute regularity of service, and it can only be successful when running costs bear a proper relation to the revenue which is obtainable from the service.

During the War, aircraft was known to have been operated without any regard to cost. The one thing was efficient success of fighting in the air, and no one could, in achieving that, count the cost. But now it is a very different question, when we have to sum up the results of commercial operations in a balance sheet.

As constructors of aircraft we have to design and construct machines which will have a longer life than a military machine. Our engine constructors have to give us engines which in due time shall be as reliable as the steam engine which operates the steamship. In this connection it is gratifying to see that the Air Ministry has already obtained from the Treasury a grant of a very substantial sum of money for research and experiment, because I believe that on studious research and experiment a great deal of our progress in the future will rest.

There is a difficult time, we feel, before the Industry, but what is so gratifying is to know and to feel that we shall have the active support and assistance of the Ministry, and that working together we shall be able to fulfil our common desire in maintaining the supremacy of British aviation throughout the whole world.

Mr. N. G. Gwynne (Chairman of the Aircraft Engine Section) said: I feel quite confident that, during the very trying time of this War, no Government Department has worked so harmoniously as the successive branches of the Air Authority have done with the Aircraft Constructors. I feel sure that this has been due in a condiderable measure to the fact that there has been a Society of British Aircraft Constructors. I think it will be admitted by every constructor here that, when the Air Ministry has got into its stride, we shall find nothing but assistance and help from every single Department of the Air Ministry, and that in the new Civil Administration the same good feeling will endure and increase, and that the Air Ministry will assist the aircraft constructor, so that in Peace as well as in War this country will hold the first place in the world's produce of aircraft—production and flying.

In conclusion Mr. G. Holt Thomas proposed the toast of the Chairman, which was most enthusiastically received, the Secretary of the Society, Mr. Charles V. Allen, being coupled with the toast.

AIRISMS FROM THE FOUR WINDS.

Postponement of the Royal Naval, Military and Air Force Tournament at Olympia has been found to be imperative. It is now down for June 26 to July 12, both dates inclusive.

We're somewhat optimistic ourselves in regard to aviation, as possibly our readers may have surmised before now, but we must give the palm to Genl. Seely, who, at the Ritz Hotel, Paris, last week, upon the occasion of a dinner by Sir George Riddell to the British correspondents, is reported to have said that he was assured by air experts that there was no reason why aeroplanes should not travel at 800 miles an hour before long, which would enable one to breakfast in London and lunch in New York.

Now we are waiting for the names of those experts.

Evidently Genl. Seely is no dunce as a picker-up of unconsidered trifles. Report further hath it from him that a remarkable chance discovery has resulted in obtaining an increased speed for aeroplanes. It was decided to cover in the passengers' seat on a D.H. 4 aeroplane, for the comfort and convenience of important personages travelling by air between London and Paris, and it was found that the cabin decreased the resistance offered to the air with a consequent increase of speed of about 10 miles an hour, an increase which would otherwise only have been attained by adding about 90 h.p. to the engine capacity.

About the most persuasive argument we know of is the one which apparently was employed most effectively last week in connection with the Cairo riots. The unruly crowd of about 3,000 which had rushed the station at Galiub and the tramway station were apparently having it all their own way, temporarily, when an aeroplane took a hand in the game, and sweeping down was the means of dispersing the "demonstrators" in double-quick time. Yes, a very sound "plane" argument.

London's Flying Club at Hendon looks like having a big success in the near future. The idea by this means, of co-operative distribution of cost and expenses, has sound common-sense at its back, and should be but the forerunner of similar clubs throughout the country, and, in fact, the world over.

Mr. J. H. Thomas upon his return to Henden Aerodrome last week, after his flight to Paris and back, to interview Mr. Lloyd George, speaking of his experience while travelling through the air, is reported to have said, "It was like nothing on earth"; which sounds like quite an original train of thought in relation to precipitation through the cerulean blue.

Stunting through and under bridges must be quite a fascinating form of flying, for a litfle time back, under the Hohenzollern Bridge at Cologne has been a favourite mark of our pilots Rhine-way, although the feat has not been entirely devoid of exciting experiences. And now Sydney Pickles has revived it this side by a clever passage through the towers of the Tower Bridge on a Fairey machine. But all the same, it's no novice's game at present.

Sweden is pretty alive to the possibilities of aviation as a source of revenue, the Riksdag classing it with precious stones as a suitable "luxury" on which to rest taxes. It is, by this means, proposed to place a premium upon tickets for flying trips.

That mild grumble of "N.C.O. Pilot" last week does not appear to be reflected in general amongst his brother N.C.Os. In fact, from communications received, his reference to the "unfortunate" N.C.O. is particularly unwelcome. To give "N.C.O. Pilot" his due, we do not think he in any way used the expression in the sense attributed to him. Here is one of the communications, on behalf of "many pilots without pips," dated from Yeovil :—

"In a recent communication published in your valuable journal reference is made to a number of cadets who are 'unfortunate' enough to be classed as N.C.O. pilots. A number of similar paragraphs which have appeared in the Press lately are causing the public to look upon the N.C.O. pilot as an inferior kind of being; and this is very unfair to the old type of N.C.O. pilot, who did not want a commission, although in many cases as well qualified to hold it as the present-day cadet.

"Among their numbers one can number Reggie Carr, Jack Alcock (pre-War pilots of undoubted ability who flew as

THE MARCH OF THE GUARDS.—A snap of a Handley-Page machine as it passed over Buckingham Palace and the Victoria Memorial.

FLIGHT

Crime in the R.A.F.

N.C.O. and P.O. pilots for a considerable time), Mottershead, V.C., and others, including one, well known in the Service, who has over 3,000 hours to his credit and has flown every type of machine ever used by the R.A.F. or R. F. C.—that with three years' service as an N.C.O. pilot.

"I can assure you that the slur cast by 'N.C.O. pilot' is bitterly resented by the pukka holders of that rank, who flew for the sheer love of flying, and not for the doubtful advantages gained by 'pips' and a microscopic balance at Cox's; and who, in many cases, reverted from higher non-commissioned rank in order to fly: and none were more concerned than these when the decision was made public to allow cadets who could not pass the elementary technical examination in full to train as N.C.O. pilots.

"Furthermore, I would remind 'N.C.O. Pilot' that if he had wished to join the French Aviation Corps he would have been compelled—and very properly—to fly as an N.C.O.

"The general tone of 'N.C.O. Pilot's' allusions to the Force of which he is apparently an unwilling member also do not strike one as becoming from an aspirant to commissioned rank."

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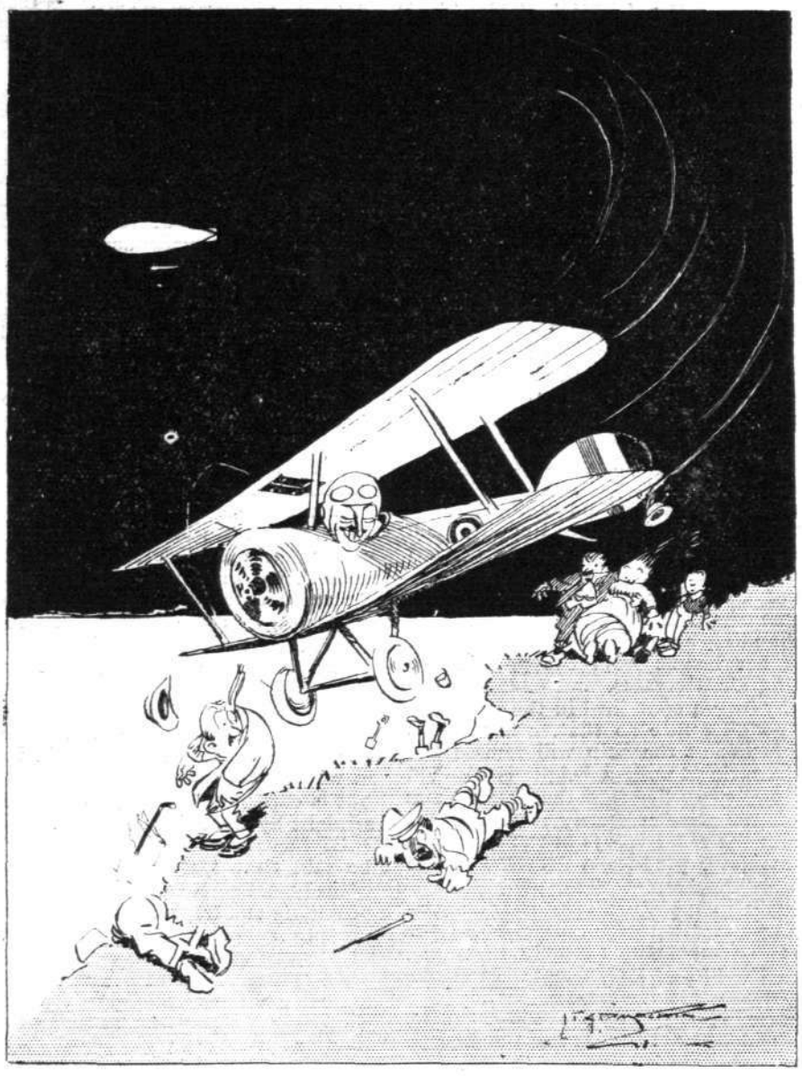
AND here's another view of the case, as put forward by "N.C.O. Pilot," from "Flight Cadet":—

"I would like to correct 'N.C.O. Pilot's' grievance which appeared in your issue of March 20.

"In the first place the classification of N.C.O. pilots and flight cadets depended on their conduct and capabilities and not on their previous service. A fair percentage of flight cadets were people who had not seen any previous service.

"Also at Oxford an order was issued to the effect that no responsibility would be held by the R.A.F. or Government for uniforms purchased privately. Although it was permissible to wear R.A.F. uniform, it was in no way encouraged by those in command."

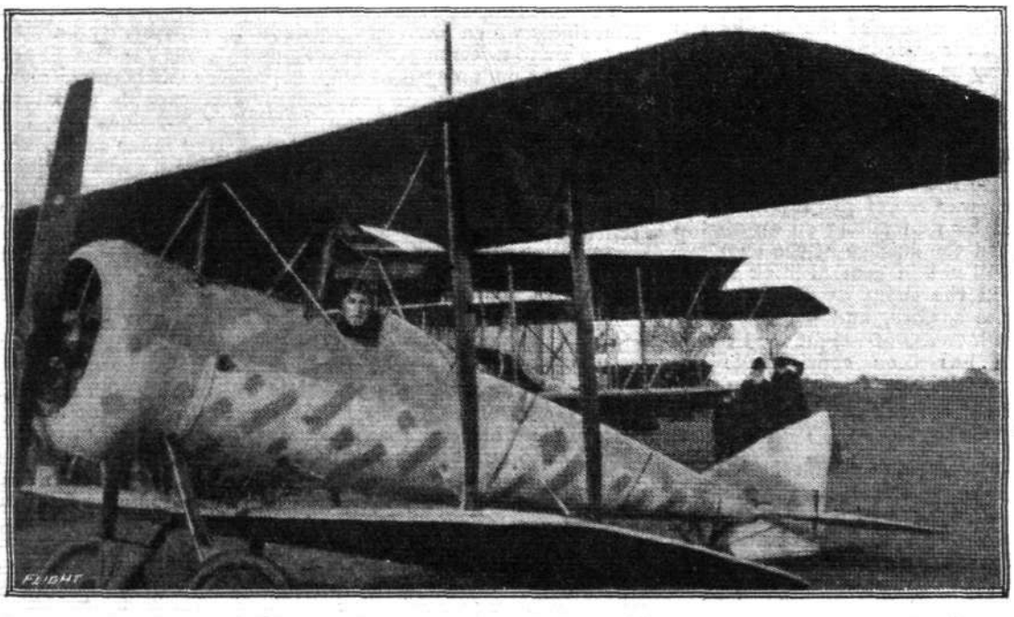


Contour chasing around the South Coast

◈ ◈ ◈ ◈

Through the Tower Bridge

FLYING one of the Fairey variable wing seaplanes, fitted with a 375 h.p. "Eagle" Rolls-Royce engine, Mr. Sydney Pickles, in the course of a flight down the River Thames on March 21, passed between the upper and lower cross structures of the Tower Bridge. According to Mr. Pickles, the machine was flying at 120 miles per hour when it passed through the bridge. He started from Isleworth at 10.40 a.m. It may be recalled that Mr. Frank McClean, on a Short seaplane, flew under the bridge in 1912.



An American camouflaged speed scout, the Berckman, built by the Berckman's Aeroplane Co. It is equipped with a G. V. Gnome.

Courtesy "Aerial Age" (U.S.A.).

FLIGHT AIRCRAFT ENGINEER

MARCH 27, 1919

LIGHTER-THAN-AIR CRAFT*

By LIEUT.-COL. T. R. CAVE-BROWNE-CAVE

SINCE I was asked in September last to read this lecture conditions have so changed that it has been necessary totally to re-cast and re-write what I then proposed to say. A large amount of information as to the actual achievements of airships has been published and also perhaps an even larger amount of speculation as to their future possibilities. What will, therefore, probably be of interest to a technical society such as this is a general outline of the ships as they exist at the stage to which they have been developed during the War.

In order to make clear the various matters which influence the lift and behaviour of an airship, I have introduced a small amount of aerostatics which will appear obvious and unnecessary to many, but may help others to the understanding of the more interesting points treated later.

The extent of the detail which I have been allowed to include in the lecture, although such matters have not been published before, leaves the Society with a very deep debt of gratitude to the Admiralty.

Factors Governing the Variations of Lift of an Airship

An airship derives her lift from the difference between the weight of the structure and all parts of the airship and the upward force on the airship, which is equal to the air which she displaces. The majority of this displacement is that due to the part of the ship which is filled with gas.

The variation in lift of the ship will, therefore, depend primarily upon the volume of gas in her envelope and upon the density of the surrounding air.

As the ship increases her height from the ground the density of the surrounding air decreases, and owing to the decrease of pressure the hydrogen contained in the gas space will expand at a corresponding rate so that, other things being equal, the available lift of the ship will remain the same. This process will continue until a height is reached at which the air has been totally expelled from the air chambers and further expansion of the gas necessarily results in the discharge of some gas from the relief valves in the envelope. Any further rise will, therefore, produce a decrease in the lifting power of the ship.

Alteration of atmospheric temperature is usually accompanied by a corresponding alteration of temperature of the gas, and providing the two temperatures remain the same, there will be no effect on the lift, so long as gas is not discharged from the envelope.

Variations in barometric pressure, *i.e.*, density of the atmosphere, affect both the density of the air and the density of the hydrogen, and a ship which is full of gas will, therefore, have considerably greater lift on a day when the barometer is high. This indicates that the lift of a ship may be expected to be good during cold weather with a high barometer. Summarising this in symbols :—

Lift $= V (Pa - Pn)$ where V = volume of gas space, Pn = density of gas, Pa = density of air displaced.

An important variation in lift is caused when the airship is exposed to the heat of the sun and the temperature of the gas inside the envelope becomes higher than the temperature of the surrounding air. The extent of this difference of temperature will vary with the strength of the sun and also with the rate at which the surface of the envelope is being cooled by the passage of air over it. This difference under certain circumstances may be very large and may vary rapidly. Instances have been recorded in which there has been a difference of over 30 degrees F. between the gas and air temperatures. The gas temperature reckoned on the absolute scale was then some 6 per cent. higher than that of the atmosphere and a "false lift" of 6 per cent. of the total displacement of the ship was therefore produced.

The reduction of lift caused by rain falling on an airship is comparatively small provided the surface of the envelope is made waterproof. Snow will not in general stick to the surface of an envelope, but in the event of melting snow sufficiently wet to stick to the surface, and possibly later to freeze on to it, considerable increase of weight might very rapidly be acquired. There has been considerable experience of ships meeting snow while in flight, and as far as is known no serious trouble has actually been experienced due to snow sticking to the surface of the envelope.

Distribution of Weight and Rigidity of Envelope

The problem of suspending a weight from the lightest possible gas container is one which involves careful consideration of the ordinary principles used in calculating the distribution of loads and bending moment in ships and similar structures. The rigidity of the gas container may be provided in various ways. The simplest is to make it solely of a perfectly flexible fabric with no rigid stiffening whatever. Such an envelope is referred to as a non-rigid. It is kept distended to its correct shape by the internal pressure which is maintained slightly in excess of the pressure outside. Fabric may be regarded as capable of resisting tension and a considerable amount of shear, but it is, of course, incapable of resisting compression. A single concentrated load suspended below the envelope will tend to produce compression in the underside of the envelope, partly by reason of the inward pull of the riggings, some of which must necessarily be inclined from the vertical, and also by any bending moment due to any lack of uniformity of distribution of load over the length of the envelope. The internal gas pressure produces a longitudinal tension in the fabric. If the compression due to the riggings exceeds the tension due to the internal pressure the envelope will deform.

An alternative method of maintaining the shape of the gas container is to form the hull of the ship as a rigid structure of sufficient stiffness to maintain its own shape independent of any internal gas pressure. The forces tending to deform this structure will depend upon the distribution of loads and upon the distribution of gas inside the hull. Ships constructed on this system are described as rigids.

Intermediate between these two main types there is one referred to as the semi-rigid. This class is provided with a rigid keel of sufficient strength to maintain its rigidity under the action of the various loads of the ship. The keel is carried by the envelope which contains the gas, but unlike the rigid the envelope is dependent for its shape upon the excess of internal pressure. There is yet another type, one which is extensively used in Italian airship construction, in which the keel is not capable of taking a bending moment but is capable of taking longitudinal compression when held straight by the main envelope.

Of these various types of construction it may generally be said that for small ships the non-rigid arrangement is entirely satisfactory as the envelope is amply capable of providing sufficient rigidity with reasonably small internal pressure. For very large ships it becomes necessary to divide the gas chamber into a number of compartments for a reason which will be explained later, and also the large diameter would render the tension in fabric caused by the necessary excess of internal pressure very considerable. For this reason a rigid structure, which calls for no excess of internal pressure, will almost certainly have to be adopted for airships of the largest class. The semi-rigid is a type which has been practically undeveloped in this country. The Italians, however, have done a great deal of work on ships of this description, but it appears very doubtful whether, all other things being equal, there is much to be gained by the addition of a rigid keel to a non-rigid envelope. The keel of a semi-rigid ship has to be sufficiently strong to take the loads of the airship without the assistance of the envelope, because in the event of pressure in the envelope falling the keel would collapse, and the ship could not be restored to her correct shape by making good the pressure in the envelope. Non-rigids which have lost pressure have frequently buckled in the air to a seemingly alarming extent, but have continued their flight undamaged as soon as pressure has been restored. The Italian system of providing a keel capable of taking only longitudinal thrust is an extremely ingenious one, but it is not found in actual practice that very much advantage in overall height of the ship can be effected by this method. This, of course, is due to the fact that the points of attachment of the riggings are moved down from the level of the centre of the envelope to the level of the keel.

The design of the envelope of non-rigid ships is a matter which requires a very considerable amount of careful consideration.

The overall height is restricted by the size of the airship shed and also by the power of the elevators which are required to incline an airship of which the car is far below the centre of the envelope. If the weight is concentrated and placed close to the envelope the riggings necessarily lie at a very flat angle and exert a serious longitudinal compression. This has to be resisted by a high internal pressure, which in turn causes great circumferential tension and involves the use of correspondingly heavier fabric for the envelope. The general consideration of the rigidity of an envelope is one of very considerable complexity, and may be most conveniently tackled by arranging a model experiment in which the lift of the gas and the distribution of load is reproduced

* Paper read before the Royal Aeronautical Society, on March 26, 1919.

in a small envelope filled with water and inverted, the weight of the water acting downwards corresponding with the lift of the gas acting upwards in the full size ship. The load is taken by a number of wires arranged similarly to the riggings and passing over pulleys which support the equivalent of the load of the airship. The weight of the planes and other envelope fittings can similarly be represented. Pressure in the envelope is maintained through a tube connected to a water reservoir, the level of which can be varied. A convenient method of determining the pressure in the water model, which shall correspond to similar pressure in the airship, can be obtained as follows :—The pressure in an airship could be maintained at any desired value by fitting an open-ended hose to the bottom of the airship and filling the airship with gas until gas issued from the lower end of the hose. If the end of the hose is at a distance of *M* metres below the bottom of the envelope the pressure of gas at the bottom of the envelope will, as explained later, be *M* millimetres of water above atmosphere. Similarly in the water model, the height of the free surface of water above the envelope corresponds to the internal pressure at that point and as the dimensions of the model and the envelope have been arranged correctly to scale, the comparison is a direct one. For example, if the diameter of the airship is 15 metres, and it is desired to maintain a pressure of 20 mm. of water at the bottom of the envelope, the length of the open hose must be equal to 20 metres, *i.e.*, 20/15 of the diameter of the envelope. This is reproduced in the water model by maintaining the water surface at a distance above the envelope equal to 20/15 of one diameter.

The method of carrying out these experiments is a very simple one. The various loads are distributed along the envelope and the pressure is reduced until the fabric begins to pucker at some point. The value of this pressure is noted.

The distribution of load may then be varied in order to reduce the compression in the fabric at this point.

It is desirable to arrange the water model so that the whole system can be inclined up or down at one end in order to reproduce the conditions of the airship pitching. Provision against pitching occasions greater difficulty than the mere satisfactory suspension of the load when the ship is on an even keel. It is not possible to give any simple rules for arranging the rigging of the non-rigid ship, but one system which has been found generally satisfactory is to lead wires from points distributed along the envelope at intervals suitably proportioned to the lift of gas at each section. This provides for the suspension of the load on an even keel. Independent wires should then be provided to prevent " fore and aft " motion of the airship car when the ship becomes inclined. It will easily be seen that the tendency to deform the envelope very materially reduces as the distance of the load from the envelope is increased and also if the load can be divided into one or more separate units.

The point at which the riggings are attached to a circular envelope is necessarily some distance below the axis. If it is possible to raise the level of these points of suspension to a higher point on the envelope, the height of the ship can be correspondingly reduced.

Further, the direct longitudinal compression due to the riggings is applied at a point considerably above the axis of the ship, *i.e.*, at a point where the difference of pressure and therefore the longitudinal tension of the ship is greater than at the lower levels. This principle was satisfactorily achieved in the system invented by a Spaniard, Signor Torres Quevedo, and subsequently developed by the Astra Company of Paris.

The envelope is made of trilobe cross section and the riggings are led into the envelope at the bottom ridge and parted into two fans of strings secured to points along the top ridges.

To constrain the envelope to this trilobe shape, curtains of ordinary unproofed fabric are laced to the ridges. These do not, however, divide the ship into separate gas compartments.

The system adopted by the Parseval Company is to provide a strong rigging band as a kind of girdle on the lower part of the envelope. To this the car is attached. The shape of the envelope is maintained by reinforcing bands of webbing stuck to the surface of the envelope along trajectories, the position of which is determined by experiment.

Both these systems and also the semi-rigid design involve considerable complexities and are only rendered necessary in order to suspend a concentrated weight as close as possible to the envelope. If, however, it is not necessary that the weight should be concentrated and it is possible to distribute the majority of the weight in a number of separate cars or along the envelope itself, these systems and the complexities they involve can be abandoned.

Structure of Rigid Airships

The framework of a rigid airship consists of a number of rigid longitudinals connected by a number of transverse members, which form rings at intervals along the length of the ship. Each of these rings is braced in its own plane by a number of radial wires. The gas bags are placed in the compartments between these bulkheads of radial wires. The outer cover is stretched over the outside of the framework.

In order to transmit the upward pressure of the gas bags to the framework, nets are provided and attached to the inner edges of the various rigid members of the framework.

The weights carried by the ship are mostly placed in a strong keel, which runs along the bottom of the ship. The function of the keel is primarily to distribute the load of these weights to the main transverse sections of the ship. The cars which are suspended below the hull of the ship are also attached at points which bring the load on to the main transverse bulkheads. Special lift wires are arranged, in addition to the radial wires, to transmit the load of the keel to the upper part of the framework.

If, for any reason, one gas bag becomes much less inflated than those on either side of it, there will be considerable pressure tending to bulge the radial wires towards the empty bag. Tension in these wires may produce very serious compressive strain in the transverse members, and in order to assist in resisting the bulging action an axial wire is often led along the axis of the ship and secured to the wires of each bulkhead.

Sub-division of Gas Space in Large Airships

The necessity for dividing the gas space into a number of separate compartments is not primarily due to the possibility of losing the whole of the gas from one compartment by leakage from external damage to the fabric. As long as an airship remains on an even keel the pressure at the two ends of the ship will be approximately the same, but if the airship be now placed vertically head upwards the excess of the internal pressure at the top of the ship over that in the air outside will be considerably greater than that excess at the bottom of the ship. This is due to the difference in weight of a column of air and a column of hydrogen equal to the length of the ship. The same variation of internal pressure will obtain in a lesser degree when an airship in ordinary flight has one end raised considerably above the other. It is convenient to remember that this variation of the difference of pressure amounts to 1 mm. for each metre difference in level. In the case of a non-rigid, which has to maintain a minimum difference of pressure between the inside and outside of the fabric of 15 mm., the effect of having the bow of the ship raised considerably above the stern will produce a large increase of pressure difference in the bow and consequently an increase in tension of the fabric at that point. In a short ship this increase of pressure due to inclination of the ship is small, but in ships of great length the increase would be a serious one. For this reason it becomes necessary to divide a long ship into a number of compartments, but this is only effective if the bulkheads, which isolate one compartment from another, are capable of maintaining difference of pressure between their two sides. In a rigid airship which has a number of separate gas containers arranged inside its structure this division is effective. There is, therefore, no accumulation of pressure at the higher end of the ship. The radial wires which form the bulkheads between the gas bags are capable of withstanding a certain difference of pressure between the gas on the two sides of the bulkhead.

Sub-division of the gas space is also desirable in order to avoid the surging of gas from one end of the ship to the other. An airship partly filled with gas would, if not subdivided, tend to be very unstable as the gas would tend to run to whichever end happened to be the higher. In a non-rigid ship this surging is satisfactorily avoided by subdividing the air space into a number of ballonets so that the air in each can only move a short distance forward or aft.

Attachment of Rigging Wires to Fabric

A steel wire may be attached to fabric and communicate the load to the envelope by passing it through a tubular D-piece, round the outside of which are laid strips of webbing. These are stuck to fabric foundations which are extended over a small portion of the envelope. This construction serves satisfactorily to communicate the tension in the wire to the envelope and to give reasonably good distribution of stress.

Blowers

In order to maintain the pressure in a non-rigid envelope, blowers of the ordinary low pressure rotary type were originally

provided. These were driven either from the main engines or by separate small petrol engines. They occasioned, however, a very fruitful source of breakdown. It was subsequently found possible to replace them by what is termed a blower pipe, arranged to collect air from the slip-stream of the propeller and to discharge it into a duct which distributes it to the various ballonets of the ship. The energy required to provide this air at high pressure was derived at the expense of a slight increase in head resistance, and in order to avoid this, arrangements were made whereby the blower pipe could be hinged about its top end and folded up along the under surface of the envelope.

A method which is employed in Italian airships is to derive the pressure from the extreme bow of the envelope. The sufficiency of this pressure will be discussed later.

The distribution of this air to the various ballonets necessitated the use of shut-off and non-return valves. These were originally made from sheet aluminium and gave very considerable trouble. It was found, however, that fabric valves arranged in the form of a sleeve, which can be partially turned inside out, gave very effective results. This valve is referred to as a "crab-pot." It is very easily operated and is almost completely airtight. The diagram shows the arrangement of blower pipe and valves on the smallest type of ship.

To enable pressure to be maintained when the main engines are not in use an auxiliary blower is necessary. The rotary type of blower driven by a separate small engine was used for a considerable time, but proved capable of improvement both as regards space occupied, reliability and efficiency. A new type of blower was devised and consisted of a small specially designed propeller discharging into a shaped casing, shaped so as to avoid as far as possible all loss due to eddies. The shape of this orifice was very carefully determined and a large boss fairing was fitted to the propeller.

Careful tests made by measuring the horse-power and output of air showed that for the same horse-power and discharging against the same head the new blower would deliver three times the amount of air previously discharged by the rotary blower.

Airship Valves

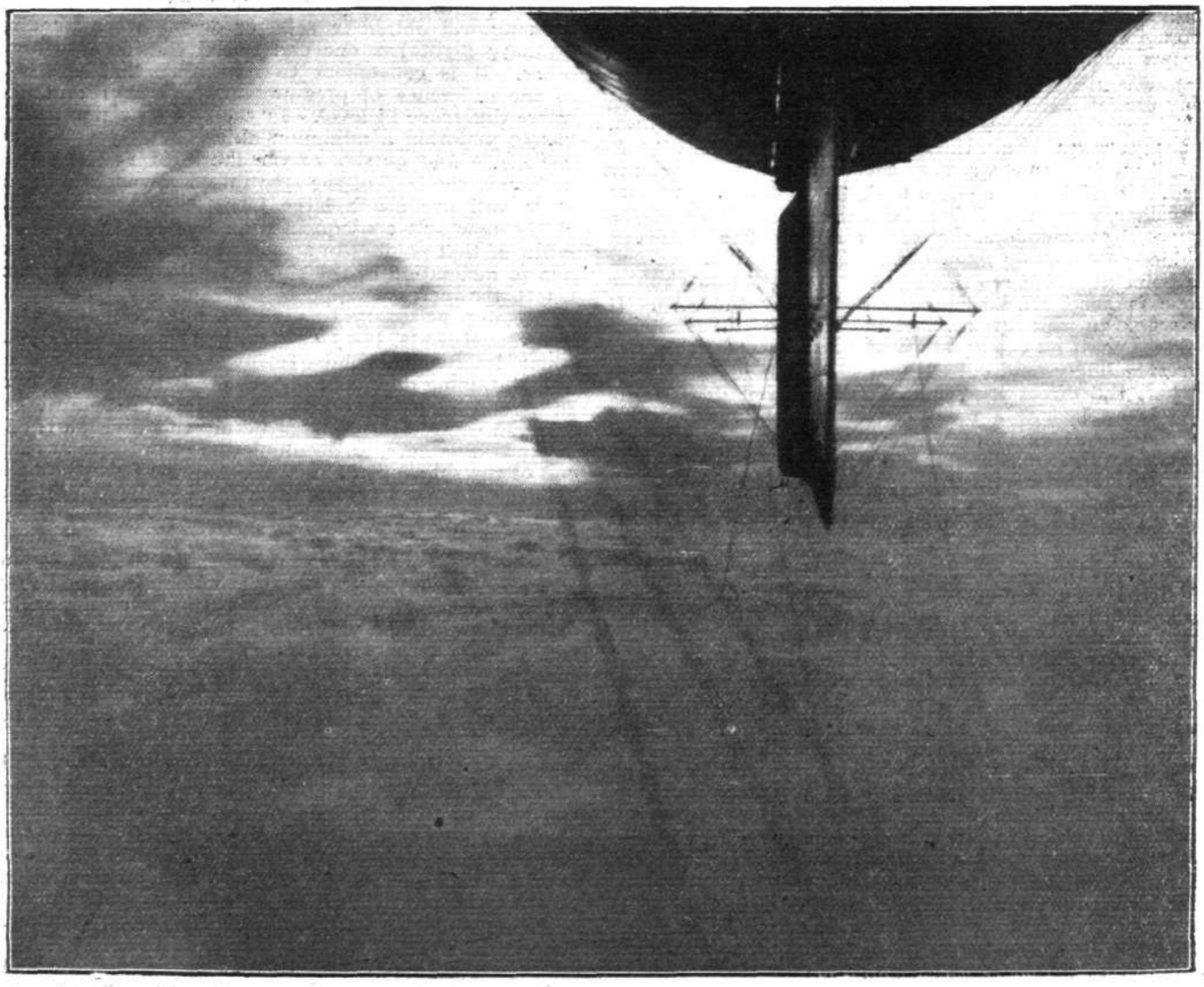
In order to prevent the pressure in the envelope exceeding a predetermined maximum and causing danger of bursting, valves are provided to relieve the pressure in the ballonets and in the gas space. The valves are made automatic in their action, and the gas valve is set to blow off at a pressure somewhat in excess of that adopted for the air valve, thereby ensuring that an increase of pressure is first corrected by discharging air from the ballonet valves. If this rate of discharge is insufficient the gas valve then lifts, but the discharge of gas is avoided wherever possible.

It will be realised that if these valves were constructed and spring loaded in the ordinary way, the pressure of the valve on its seating would be gradually reduced as the pressure inside the envelope increased. When blowing off point was nearly reached there would be a considerable period while the valve was only very lightly pressed on to its seating and when leakage was extremely likely to take place. The mechanism of the valve was, therefore, arranged so that the force tending to cause the valve to open decreased as the valve opened, and the result produced was, therefore, that the valve would remain on its seating until the predetermined pressure was reached. It then opened wide and would remain open until the pressure had fallen slightly below that at which the valve opened. This gives a very determined action and materially reduces the amount of leakage from a valve while it is "stuttering" in the very slightly open position.

The gas valves used for relieving pressure in a rigid airship are fitted in the lower part of the bag where they can be reached from the keel gangway. They are automatic, but are much larger and loaded to a much lower pressure. In addition to these relief valves, hand-operated manœuvring valves are fitted at the top of most of the bags so that gas can be released in order to alter the trim of the ship.

Bow Stiffening for High Speed

The pressure which it is necessary to maintain in a non-rigid envelope depends upon two things: Firstly, the pressure which is necessary to prevent the envelope from collapsing



ABOVE THE CLOUDS.—A view from S.S. 26.

under the influence of the rigging tension; and secondly, the pressure which is necessary to prevent the bow of the envelope being blown in, due to the excess of external pressure caused round the bow of the envelope by the motion of the airship forward.

It is found that the excess of pressure which takes place at the bow of the ship extends for only a short distance aft. By reinforcing this area it is possible to fly with an envelope pressure considerably lower than the external pressure at the bow of the ship.

This stiffening of the bow becomes a matter of greater importance as the speeds increase. There is always the possibility in "bumpy" weather, when the height of the ship varies rapidly, that the pilot may let his pressure fall momentarily too low. The bow of the envelope then blows in and forms a curious concave cup shape in which it remains till the speed is reduced or the pressure is raised. No damage will probably be done so long as the reinforcement of the bow is not of such a nature that it will break and puncture the envelope. It may very probably be necessary to provide a separate small compartment at the bow and kept at a higher pressure than that of the rest of the envelope.

This would allow high speeds to be attained without a corresponding increase in envelope tension.

Planes

In order to stabilise the motion of the ship it is necessary to provide the envelope at the after end with planes. These are provided at their after edges with rudders capable of steering the ship either vertically or horizontally. The construction of these planes somewhat resembles that of the wing of an aeroplane. Fabric is stretched over a framework and is doped in order to render it taut. The surfaces are, however, practically flat and the loading is considerably less than that provided for in an aeroplane.

The planes are supported from the surface of the envelope by guy wires attached to suitable points on the envelope, and are prevented from pushing their inner edges into the envelope by skids or wooden bearers. The importance of the rigidity of this resistance to inward thrust is very often under-estimated. A small inward movement of the foot of the plane allows the plane as a whole to sit over a serious angle. This lack of rigidity in the planes has a serious influence on the stability of the ship.

The maximum intensity of air pressure occurs towards the forward edge of the planes, and it is therefore desirable that the leading edge should be short. The long narrow plane, increasing in width as it goes aft, is therefore adopted in preference to that of large aspect ratio which, although aerodynamically more effective, would be much more difficult to hold with adequate rigidity.

The planes of a rigid ship are attached rigidly to the hull framework. In the latest German ship these planes are made some 6 ft. thick at the root, and faired off into the rudder and tapered to the outer edge. They are, therefore, almost totally self-supporting and require no guy wires.

Fabrics

The fabrics used in airships are of three main types :—

1. Gastight fabric, such as that used for gas bags of a rigid ship.

2. Outer cover fabric, of which the principal function is to form a rain and weather proof outer cover to the ship, both as a fairing to reduce her resistance and to protect her internal bags from variations of temperature, due to radiant heat, and from deterioration caused by sunlight.

3. The envelope of a non-rigid ship requires a combination of both properties.

Gastight Fabric.—The lightest method of rendering a fabric gastight is the application of goldbeater's skin. This material is a membrane which, although water will easily pass through it, has a very pronounced ability to resist the passage of hydrogen. The skins are obtained from the messentry of a cow, each animal contributing a piece which averages about 8 in. by 20 in. These skins are stuck to the fabric by means of glue or rubber solution, and are varnished to protect them against moisture and damage.

The gastightness of a non-rigid envelope is obtained by rubber proofing only. The same fabric has to fill the functions of outer cover, as stated above, and also has to withstand considerable stress produced by the internal pressure of the gas and by the tension of the riggings attached to it.

In order to obtain the necessary strength—and more particularly strength to resist tearing—a number of plys of cotton fabric are stuck together with layers of rubber solution between them. Fabric for small size ship can be given the required strength by two plys of cotton, the inner one being diagonal. Stronger fabric is usually made of three plays, the middle of the three being diagonal. The diagonal ply is formed by cutting strips of fabric and sticking them to the other ply so that their threads run at 45° to the threads of the main ply and to the length of the built up strip of fabric. These diagonal threads have a very pronounced effect in distributing a stress evenly over threads of the main ply.

The rubber is made into a thick solution and spread by a kind of scraping knife on to the layers of fabric before they are stuck together.

The rubber on the outer surface usually contains aluminium powder as this forms a surface that reflects much of the radiant heat, thus preventing rapid temperature change, and is also opaque to the light which would injure the fabric inside. It is usually found that the outer layer of proofing has perished so badly as to be easily noticeable before the strength of the fabric has become appreciably reduced by weathering.

Outer Cover Fabric.—Outer cover fabrics generally resemble the fabric used on aeroplane wings. It is necessary that after the outer cover is placed on the ship a certain degree of contraction should take place in order that the cover may be well tensioned to resist any tendency to flap. It is found that a contracting cellulose acetate dope is generally most satisfactory but the extent of the contraction must be considerably less than that customary on aeroplanes. If the contraction is excessive it is liable to bring a serious crushing strain on the framework of the ship.

Considerable difficulty has been experienced in obtaining a satisfactory dope for the outer cover, but its function in resisting light and heat and in providing a waterproof covering, are so closely analogous to those fulfilled by the latest aeroplane dopes that it is probable aeroplane practice will be adopted, the only modification being a considerable reduction in the amount of contraction allowed.

The outer cover of a rigid airship constitutes a very serious problem because the unsupported areas of the fabric are large, and it is of the utmost importance that no part of the fabric should flap or even tremble to a small extent. Such action would very rapidly increase and in the prolonged flights which these ships have to make, very serious results might follow any small flapping which was allowed.

Engine Requirements

Our very extensive experience of airship flying, extending over nearly 3,000,000 miles during the war, has shown that by far the most fruitful cause of failure is connected with the engines. This is the case although a large proportion of the small difficulties which occur in aero engines are of a type which can be made good in an airship, but not in an aeroplane The length of time for which an airship's engine is running continuously is very considerably greater than that of an aeroplane. The requirements to be expected from a good airship engine therefore differ from those of an aeroplane engine in several important respects :—

1. The engine must be suitable for running for very long periods without breakdown.

2. All gear on the engine must be arranged so that small defects can be made good in the air, the engine, if necessary, being stopped for a short period.

3. The fuel and oil economy, more particularly at reduced powers, are of far greater importance to an airship than is the initial weight of the machinery.

Although these differences between the requirements of airships and aeroplanes exist at the present time, they will be very considerably reduced as soon as the aeroplane develops into a machine of longer range and capable of flying with a smaller proportion of its power. The airship engine requirements of to-day are very largely the requirements which the aeroplane will call for to-morrow.

Useful Carrying Capacity

The carrying capacity of an airship is perhaps the feature of greatest importance both from a Service and commercial point of view. The weight, which is available for bombs, passengers, merchandise, or fuel, depends upon the volume of gas contained by the ship and upon the weight of the ship's structure and all necessary parts. The volume of gas will increase as the cube of the linear dimensions of the ship, and it will be readily understood that the weight of the ship will not increase as such a high power. This indicates that as the size of the ship increases the proportion of her gross lift which is available for lifting capacity will also increase. The non-rigid ship having no hull structure will for the same size have a considerably greater proportion of available lift. It may be assumed that it is at the present time practicable to design both a rigid ship and a non-rigid ship which will be able to carry as useful load a weight equal to that of the ship, *i.e.*, 50 per cent. of the gross lift of the ship will be available for useful purposes. The size of a non-rigid which will

give this ratio is approximately 500,000 cub. ft., and for a rigid approximately 2,000,000 cub. ft.

For many commercial purposes there is much to be gained by carrying a given weight in several small ships rather than in one large one. For naval purposes, when the airship is used as a cruiser, her function is to carry observers and a wireless telegraph installation for a certain distance at a certain speed, and a ship that will do this with a small crew is as effective as one with a big one. To this it must be added that the small ship can get away on a large proportion of the days when the larger ship would be weather-bound. The best figures which are available as regards the cost of our largest rigid and non-rigid indicate that some six of the non-rigids referred to above could be built for the same price as the equivalent rigid referred to.

Water Recovery and Use of Hydrogen as Fuel

An airship which is making a long passage extending over several days has to contend with difficulties due to changes of temperature.

The change of temperature, and more particularly the change in the amount of radiant heat by day and night, is often very great. Let us trace the history of a ship which leaves the ground in the early morning before sunrise.

As the day advances she warms up and her lift will probably increase, due to superheat and the petrol she has burnt. Unless she is prepared to keep herself down by using her elevators and flying nose down, she must rise and lose gas. Later in the day, when the superheat disappears, the ship may become seriously heavy due to the amount of gas she has lost. It is important, therefore, to reduce the gas lost, and this can best be done by avoiding the necessity of allowing the ship to go to a considerable height. For this it is necessary to take weight into the ship. This can be done by picking up water from the sea or by condensing the steam formed in the engine exhaust. The first method is only possible over the sea and by coming down to a low height. It even then presents considerable difficulty. There is, however, the advantage that a large weight of water can be picked up quickly when required. The weight of water that can be condensed from the exhaust is theoretically more than 20 per cent. in excess of the corresponding weight of fuel burnt, but it is found in practice that to collect more than about 80 per cent. of the petrol weight would necessitate very heavy condensers.

It is almost certain, however, that at many times during a long journey it will be necessary to discharge gas and arrangements have therefore been made to use the gas as fuel.

Experiments were first made in burning hydrogen alone as fuel in the engine, but it was found only possible to develop about one-third of the maximum h.p. of the engine. If a greater quantity of hydrogen than this was burnt serious detonation took place in the cylinder. Trials were, however, carried out by using both hydrogen and petrol, each mixed with the correct proportion of air. By varying the proportion of hydrogen mixture and petrol mixture, it is possible to obtain all powers up to the maximum of the engine. At the higher powers only a smaller proportion of hydrogen can be burnt without trouble. No serious difficulties were experienced with the use of hydrogen as fuel, but it has been considered desirable that the gas should be drawn from the envelope at a pressure less than atmospheric in order to avoid any possible risk of fire. A spring-loaded non-return valve is fitted in the hydrogen discharge pipe and is loaded to a pressure considerably in excess of that which will ever be attained in the envelope. The suction of the engine is sufficient to draw the hydrogen through this valve, but if for any reason the engine stops no further hydrogen passes. The apparatus has been most thoroughly tested to eliminate risk due to fire, and it appears quite certain that at the present time the risks from a hydrogen fire with this gear are quite negligible.

Types of Airships Developed During the War

The present classes of British airships have been gradually developed from the beginning of 1915, when the interest in airships was revived by Lord Fisher's decision that they might be made to form an important defence against the submarine. The first "S.S." ship was constructed by suspending a "B.E." aeroplane, stripped of its wings and tail, under a suitable small envelope. The trials of the first ship were made in less than twenty days from the time the instructions to proceed were received. The first flights were so satisfactory that the Admiralty gave instructions that the production of these ships was to proceed at once. There were at that time practically no firms capable of constructing airship envelopes or even of constructing airship fabric in anything like adequate quantities. The building-up of this fabric and envelope constructing organisation almost entirely among firms of waterproof garment manufacturers was not the least difficult or interesting part of our early airship development. It must be remembered that the firms who undertook this work were mostly totally unaccustomed to reading blue prints, as the whole of their cutting had been done from patterns made elsewhere. The "S.S." class of airship differed very slightly from the original ship in certain respects which had been found desirable on the first trial. A few cars of the "pusher" type which generally resembled the *nacelle* of a Maurice Farman, were constructed by a private firm, but although they relieved the pilot of the propeller slip-stream, they did not prove as satisfactory as the older "B.E." type.

It soon became necessary to construct a ship of larger size and capable of lifting a greater load and of longer endurance. An envelope of the "Astra" type was obtained from a ship which had been built before the war as a Belgian millionaire's air yacht. A suitable car to take four men was constructed and rigged below it. This again proved a satisfactory preliminary experiment and was the beginning of the "Coastal" type. The envelope had to be re-designed, but the modifications made to the car were comparatively small. This class of ship was modified in 1918 to the type known as "C*," which had again a better shaped envelope and slightly better crew accommodation in the car.

The requirements for the "S.S." ship altered somewhat, and it became desirable that the ship should be capable of landing on the water and also suitable for being towed from a seagoing ship. For this purpose the "Zero" type of car was designed and constructed at the Airship Patrol Station near Dover. No alteration of any importance was, however, made to the envelope.

A ship larger again than the "Coastal" was found to be required for extended cruising in the North Sea and for work with the Fleet, and the "N.S." ship was, therefore, designed. It will be seen that she marks a distinct departure from the earlier classes. Her machinery is in a unit quite separate from the main car, which latter only carries the crew and navigating party. The petrol carried by this ship amounted, under certain circumstances, to about three tons, and the distribution of this load constituted a very interesting problem. In the first ship it was carried in a number of tanks attached to either side of the top lobe at a convenient distance above the top ridges. Access to tanks was obtained through the gun tube, which passes up through the centre of the ship, and then down a ladder way to a walking way along the top ridges. It was not, however, considered desirable that a man should have to be sent on top of the ship every time it was desired to turn on an additional petrol tank, and arrangements were made to lead wires from the power unit round the surface of the envelope to each individual tank. This method operated satisfactorily, but difficulty was experienced with the hose conveying the petrol from the tanks to the car. The weight involved in the whole installation was also considerable. An alternative scheme was therefore designed and installed in the next ship. This provided large 90-gallon petrol tanks drawn up through the under surface of the envelope and suspended from the two top ridges by independent internal rigging generally similar to the main rigging. It is an interesting point that in the first few ships these tanks were made totally of fabric lined with a special petrol-resisting dope. Experiments on these tanks had been proceeding for a considerable time, and one tank had contained petrol for over twelve months without serious loss of petrol or any apparent damage to the dope. It was found, however, after these tanks had been in use in several ships that an alteration in the constituents in the petrol had included something which gradually softened the dope and caused cracking and leakage. As it was probable that further alterations in the petrol might be made as the war proceeded, it was decided to be desirable to substitute aluminium tanks for these fabric ones, and metal tanks were, therefore, substituted in all later ships.

The development of the rigid airship shows fewer obvious features, although it may certainly be claimed that the improvements in strength and details of construction have been very satisfactory. The most obvious change has been with respect to the main keel of the ship. This keel, it will be remembered has primarily to distribute the loads carried by the ship to the main transverse frames of the hull. In the earlier ships (as was the case in Germany) this keel was an external one of triangular section. Our next development was to eliminate the distinctive keel altogether, while in the "33" class the keel has returned, but as an internal part of the structure. It will be seen that with a rigid airship it is possible to provide spacious accommodation, both in the engine cars and in the navigating cars. It is possible for a mechanic to walk all round his engine, and except

for certain parts below the level of the crankshaft the whole of the machinery is as accessible as can possibly be wished.

In addition to the space in the cars there is ample space along the whole length of the keel for the stowage of petrol tanks, bombs, or any other form of gear which may be carried. Scarcity of space for the stowage of articles or passengers carried is a difficulty which in no way enters into the airship problem.

I will, in one respect, depart from the restriction I imposed upon myself at the beginning of the lecture, and will point out where it will be most convenient to stow articles carried in airships of future types. It is considered as a result of experience probable that non-rigid should, in future, be of circular section. This is primarily because of the difficulty of adjusting and examining the internal rigging of the "Astra" type. This internal rigging is only necessitated by a concentration of load, and if this concentration can be avoided the extra complications should not be incurred. The loads carried are most conveniently disposed inside the balloonets, and can be carried by the fabric itself without any form of rigging whatsoever.

A further advantage from the pilot's point of view is that the position of the load or the air which replaces it when discharged does not vary and the trim of the ship is not affected.

Airship Handling

Certainly one of the most interesting parts of airship engineering is connected with the handling of ships when they are not in flight. The problem of anchoring, mooring, towing, moving them over the landing ground into the shed, or securing them in temporary shelter, is one calling for as much resource and ingenuity in development as the construction of the ships themselves.

An airship, as you all know, makes her landing by flying slowly up to a landing party collected on the ground. She drops her trail rope which is taken by the landing party, led through a pulley block secured to the ground, and then used to haul the ship down until she can be taken in hand by the party. A number of guys, led from suitable points along the length of the ship, are then manned by detachments of the landing party, and the ship secured in this way can be moved about in any direction. This operation presents little difficulty so long as the ship is kept carefully head to wind. The direction of the length of the shed is, however, fixed and it may well happen that the wind is blowing across the entrance to the shed. Under these circumstances it is necessary to turn the ship broadside to the wind in order to get her into the shed. The process of entering the shed offers very considerable difficulty. A sideways force on the ship is many times greater than that due to the same wind truly end on. In the neighbourhood of the shed the wind is very seriously disturbed and forms large eddies. In many cases wind screens have been erected in order to break the force of a wind across the mouth of the shed, but it appears very probable that the unsteady flow produced by these screens renders the ship more difficult to handle than she would be if no screens at all were provided. In order to decrease the disturbance caused by these screens certain of them have been constructed with large gaps left at intervals, and others have been covered with expanded metal instead of corrugated sheeting. Both these devices tend very greatly to reduce the eddies formed by the screens.

The difficulty in handling the ship appears to be very largely due to gusts nad variations in the strength of the wind, and also to the vertical component which the wind may have derived from the motion over sheds or screens and which tends to drive the ship down on to the ground.

Present opinion appears to incline to a complete absence of wind screens and the provision of side rails and travellers to which the guys of the ship can be attached. The difficulty of taking ships into their sheds must not, however, be unduly magnified. Ships working at patrol stations have frequently been taken into their sheds in winds of 35 m.p.h. Winds such as this would, of course, cause considerable risk to a rigid ship of the largest type.

Mooring

Shortage of materials and the delays in shed construction rendered it necessary that in order to provide the great increase of airship bases required for the anti-submarine campaign, temporary arrangements should be made for mooring out the smaller airships. A very satisfactory means of arranging this was found by selecting suitable woods and cutting in them alleys leading up to small cleared spaces in which airships could be secured and protected from the wind by the trees. As long as trees of sufficient height were available it was found that this system proved most satisfactory, and many small mooring-out camps were established and satisfactorily protected their ships against winds of over 60 m.p.h.

The size of ships which can be protected in this way is, of course, limited by the height of the trees. Other arrangements for mooring ships are, therefore, necessary.

Single Wire Mooring.—The most obvious method of securing a ship to the ground is to attach her by a wire led from a suitable point in the ship to a fixed point on the ground. When secured in this way, it is found that an airship requires constant attention and steering in order to render her reasonably steady. It is found that considerable improvement is obtained by adding to the wire a dragging weight, or when secured over the water a drogue, which will, to a considerable extent, check although not rigidly resist the lateral motion of the bow of the ship. Variations in wind force are satisfactorily taken up by trimming the ship so that she lies at a small upward pitch. Any increase in wind force then causes an increase in her lift quite adequate to balance the increase in her resistance.

Three Wire System.—An improvement on this single wire system consists in securing the mooring point of the ship to the head of a pyramid formed by three long wires. The lift of the ship raises these wires off the ground, and if she is given a slight upward pitch she is able to resist the action of a steady wind. This system has proved very satisfactory.

Mast Mooring.—In both the foregoing systems there is considerable difficulty in changing crews or pumping water or gas into the ship. A much more convenient arrangement is made by securing the ship to the head of a comparatively short mast. Two methods of doing this have been proposed. The most obvious one is to secure the ship by her extreme bow point. This is a simple matter in the case of a rigid ship, but a non-rigid requires reinforcement at the bow.

Towing

The first towing experiment was carried out in 1912, when one airship broke down and was towed home by another. The towing ship landed alongside the disabled one and a wire was taken from her to a suitable point on the latter. The ships then rose and no difficulty was experienced in the towing operations. This operation in itself has not been used since, but it offers attractive possibilities for conveying large weights of material at a comparatively slow speed when the airship tug may tow a number of air barges after her.

The principle use which has been made of towing during the War is to tow an airship from a light cruiser or patrol boat. This operation in itself presents no serious difficulties. The ordinary trail rope forms a satisfactory tow line, but it is absolutely necessary that the airship should be continuously steered while in tow. It has often been suggested that an airship which could be towed without its crew would be of considerable value. Although such a process is possible with a kite balloon, the airship, which possesses considerably less directional stability, and also has not automatic gear for maintaining the pressure, would have to be radically altered before she would be suitable for towing empty. If altered so as to be stable enough to tow without crew, she would scarcely be satisfactory for ordinary flight.

Anchors

The problem of anchoring a ship, *i.e.*, securing her without the assistance of men on the ground, is one which is mainly of importance if it is necessary to prevent an airship drifting when broken down. Various forms of grapnel have been used from free balloons for many years, but an airship, which is many times greater weight, is found to acquire such momentum when drifting that she will pull out or break any ordinary grapnel. The problem of getting hold of the ground from an airship above it is much more difficult than appears at first sight. An ordinary grapnel will be dragged a considerable distance before it catches a tree or anything giving a suitable hold. A proposal was made many years ago that the airship should fire a form of harpoon into the ground and ride to that as an anchor. This question was again raised in 1916, and rough designs were therefore prepared to determine the best form of harpoon which would sink into the ground and then open so as to exert considerable resistance to being pulled out. The principal difficulty lay in obtaining sufficient penetration, and experiments were, therefore, carried out to determine the form of head which would give the best penetration. Several samples were dropped, and at the conclusion of the tests attempts were made to pull the dummy anchors out of the ground. This proved a very difficult business, and the idea of a solid grapnel which would penetrate the ground suf-

ficiently far to jamb itself securely, obviously presented itself. Considerable success was obtained. The head of the anchor was made of cast iron with a long tubular shaft, and the wire was secured to a point close under the head. When this anchor had penetrated the ground to a considerable distance and the ship had drifted so that the pull came fairly oblique, the wire cut into the ground and tended to pull the whole grapnel sideways. To such an action a very satisfactory resistance was obtained. It was still, however, found that a heavy ship drawing her trail rope suddenly taut against a grapnel such as this, either parted the trail rope or ran considerable risk of damage to the mooring point of the ship. It was, therefore, necessary to devise some suitable means of gradually absorbing the energy of the drifting ship without producing any excessive impulsive tension on the rope.

The problem of anchoring over the sea is a comparatively simple one. An ordinary drogue, formed much like a parachute, has quite a satisfactory effect in reducing the speed of a drifting airship down to two or three knots. It was thought that if an anchor was dropped so as to be on the further side of the drogue, the anchor would secure itself satisfactorily to the bottom of the sea, and the drogue would then act as a weight to resist the upward component of the pull of the ship. Under these circumstances, however, it is found that the drogue has a considerable tendency to pull out of the water. A drogue which is kept moving through the water can easily be arranged to keep itself full.

It is not easy to pull a drogue such as this out of the water when it is desired to get under weigh again, and a slip has, therefore, been arranged whereby the drogue is secured to the end of the trail rope and can be spilled from the ship.

There is much more which might be said about the handling arrangements connected with airships, but as the time available is short it is hoped that what has been given will suffice to show how far airships approach the completeness with which seagoing craft can be anchored and handled. There is, however, one important point to which it is desirable to draw attention in connection with the development of large aircraft. It is often advanced as a handicap inseparable from the airship that she requires a large handling party. When all things are considered for aircraft carryiug the same disposable load the advantage appears rather to be with the airship. An airship, however large she may be, can be landed with as little difficulty as can the smallest airship. She can be brought slowly over the landing party, and can be taken in hand on any ground which is reasonably free from obstruction. She can then be made considerably lighter than the air she displaces so that the force which the landing party has to exert is mainly a downward one. Provided the aerodrome is clear and the surface good enough for the landing party to walk over, the ship can then be carried into her shed.

Compare this with the large aeroplane, which must necessarily have a considerable horizontal velocity at the time it touches the ground. It must have a clear space of smooth hard ground to run for a considerable distance, and when it has come to rest it presses on the ground with the whole of its total weight. Under these circumstances its handling over any but the most carefully prepared ground is a matter of considerable difficulty.

The difficulties connected with landing and handling an aeroplane on the ground will, it is considered, increase very rapidly with size, and the margin in favour of the airship is likely to increase rather than decrease.

I have tried to crowd into one evening what really requires many very carefully prepared lectures to give a reasonably correct impression of the work which has been done even during the War. You must only, therefore, regard this lecture as a peep into airship engineering, a science which those who have experience of it realise to be at least as complex and involved, but also to have at least as great possibilities, as the corresponding aeroplane work. The man who knows much more about the aeroplane than the airship must realise that his view is distorted, while everyone, if he wishes to gauge the relative possibilities of H.A. and L.A. craft, must remember that although the airship started first, the energy and talent devoted to its development has been incomparably less than that from which the aeroplane has benefited, more particularly in very recent times. One must be careful in comparing two things at widely different stages of development.

If the lecture has succeeded in stimulating in this our premier technical and scientific aeronautical institution, a new interest in and a greater insight into airship development, I am certain that the onus laid upon me by the Council, when they invited me to prepare this discourse, will have been satisfactorily discharged.

QUESTIONS IN PARLIAMENT

Balloon Factory, Finchley

Maj. NEWMAN, in the House of Commons on March 18, asked the Secretary of State for War whether the War Office has purchased or intends to purchase the national balloon factory at Finchley with a portion of the land and houses adjacent; and, if the purchase has been completed, will he give the total cost and the use to which it is proposed to put the disused factory and the land and houses purchased?

Mr. Churchill: I am not in a position to make any statement on this subject at present.

Dope Inquiry

Col. WEDGWOOD, on March 19, asked the Prime Minister when the Dope Inquiry is likely to be completed, and whether, if the complete Report is likely to be delayed beyond three months, he will ask that an interim Report be issued?

Mr. Bonar Law (Leader of the House): This Report is of necessity postponed by the absence in Paris of Lord Sumner, but I hope that it will not be long delayed.

Col. Wedgwood: Does that mean it will be issued within the next three months?

Mr. Bonar Law: I hope so. I have discussed the matter with Lord Sumner himself, and he tells me they have made good progress.

R.A.F. Pilot Pupils

Mr. MOSLEY asked the Under-Secretary of State to the Air Ministry whether observers of the Royal Air Force who are now training to graduate as pilots will be allowed to complete their course before being demobilised?

Mr. Pratt: The flying training of all pilot pupils, whether they have been observers or not, has been discontinued in the interest of public economy.

Observers (Gratuities)

Mr. MOSLEY asked the Under-Secretary of State to the Air Ministry whether the gratuities of observers who have been returned to England to undergo training as pilots are assessed upon the rate of pay which they received in France while drawing flying pay, or upon the rate of pay which they are now receiving in England, where they do not draw flying pay during the period of their training?

Mr. Pratt: Gratuities are in all cases assessed on the basic rate of pay exclusive of flying pay, and the amount is not altered by the fact of being returned to England.

Air Ministry Staff

Viscount WOLMER asked the Under-Secretary of State to the Air Minister whether wounded officers and soldiers are being discharged from the Air Ministry while civilians and girl clerks are being retained?

Maj.-Genl. Seely: In the reduction of staff which is at present taking place those airmen who have been demobilised have been so treated at their own request. Several wounded officers, whose work has come to an end, have also been discharged. The work on which girl clerks and civilians are employed is unsuitable for officers.

R.A.F. Carpenter Ratings

Mr. HANCOCK, on March 20, asked the Under-Secretary of State to the Air Ministry whether air mechanics entered into the Royal Naval Air Service as carpenter ratings, and who brought their own tools with them into the Service, were entitled to 3*d*. per day as tool money; and, if so, when will this money be paid?

Maj.-Genl. Seely: In the Royal Naval Air Service the carpenters bought their own tools and received 3*d*. a day for upkeep. In the Royal Air Force the tools are issued to the men on loan and no such upkeep allowance is made. Tools belonging to ex-Royal Naval Air Service men on joining the Royal Air Force were either bought by the Royal Air Force at a valuation or sent to their homes at public expense.

Inventions (Rewards)

Maj. LANE-FOX asked the Under-Secretary of State to the Air Ministry whether any and, if so, what sum has been paid to any officer of the Royal Air Force as a special reward for the invention or development of anti-aircraft entanglements?

Maj.-Genl. Seely: The answer is in the negative.

Civil Aviation in Italy

LARGE grants of money and material have been made to the Turin Polytechnic School and to the Civil School of Aeronautics in Rome for educating experts and skilled workmen for civil aviation, says *The Times* correspondent in Milan. A special State organisation, furnished with every means, is working to prepare all those accessories which guarantee success, such as aerial routes, aerodromes, meteorological observatories, telegraphic, telephonic, and radio connections, together with an elaborate system of day and night signals, and a special salvage service for overseas trips. *Pourparlers* are being conducted with the Norwegian, Japanese, Brazilian and Argentine Governments.

Air Reconnaissance in the Sahara

SOME additional particulars are now available regarding the expedition by aeroplane and motor car towards the centre of the Sahara, recently carried out under the orders of General Nivelle, for the purpose of securing information about the regions of the Wadi Saura, Tidikelt, and the Mid-Sahara.

The possibility of an aerial and motor route joining up the southernmost posts of the Algerian Sahara with the coast by way of Colom Bechar to Insalah and Tuggurt, thus creating a basis of revictualment for penetration across the Sahara towards the Niger, is said to have been established. The party consisted of 38 Europeans, with six motor cars and four aeroplanes, and it traversed several thousands of miles.

FLIGHT

Personals

Casualties

Capt CECIL GEORGE RUSHTON, R.A.F., previously reported missing, now officially assumed killed over Bruges in action on May 16, 1918, at the age of 34, was the only son of George Alfred and Florence Rushton, of 14, Penywern Road, Earl's Court, S.W.

Lieut. JOHN VICTOR REED JACOB, R.A.F., who died at Wimereux on March 16, at the age of 21, of cerebro-spinal meningitis, was the youngest son of Maj. J. E. Jacob, Aldershot.

Lieut. LESLIE W. T. D. TRATMAN, R.A.F., who died at the 4th Northern General Hospital, Lincoln, at the age of 20, was the only son of Mr. and Mrs. Tratman, of Uleymount, Duncombe Hill, Forest Hill.

Married

Capt. KIVAS BURTON FORSTER, D.F.C., 27th Manitoba Bn., attached R.A.F., youngest son of Maj.-Gen. J. B. Forster, C.B., Colonel, the Royal Irish Regt., was married on February 4, at St. Paul's, Vancouver, B.C., to DOROTHY A., only daughter of Mrs. and the late Capt. ALLAN TAYLOR, British Service, 1256, Georgia Street, Vancouver, B.C.

Capt. H. J. LARKIN, D.F.C., R.A.F., elder son of Mr. and Mrs. H. B. G. Larkin, of Bailey's Hotel, W., and Melbourne, was married on March 15 at St. Saviour's, Paddington, to VERA GRACE RUSSELL, younger daughter of Mr. and Mrs. W. A. DOMAN, 70, Portsdown Road, Maida Vale, W.

Capt. T. R. G. ROBERTS, R.F.A., only son of the late Mr. and Mrs. Sydney Roberts, was married on March 17 at St. Saviour's, Walton Place, to ETHEL FRANCES (KIT), only daughter of the late GRANVILLE GORDON, and of Mrs. Granville Gordon.

DOUGLAS C. S. WILLIAMS, R.A.F., son of the late W. S. Williams, of Weddell Island, Falkland Islands, was married on March 19 at St. Thomas', Canterbury, Catholic Church, St. Leonards, to HELEN ELIZABETH DOROTHEA, daughter of the late LOUIS H. BARNARD, formerly of State College, Penn., U.S.A., and of Mrs. Barnard, Kenilworth, St.-Leonards-on-Sea, and granddaughter of the late "Dr." Helen Barnard-Densmore, of London and New York.

To be Married

An engagement is announced between Capt. RUPERT FORBES-BENTLEY, D.S.C., R.A.F., of Masslands, Beckley, Sussex, and RUTH HARRIETT, eldest daughter of CHARLES BRISTOW, Bank House, King's Lynn.

The marriage arranged between Maj. MAURICE WRIGHT, R.A.F., elder son of Mr. and Mrs. Arthur Wright, of 3, Addison Road, Kensington, and WINIFRED MAY, younger daughter of the late CHARLES HOLFORD COWLES, and of Mrs. W. R. Waller, of Buckhurst Hill, will take place at Christ Church, Woburn Square, on April 5.

Items

After the Investiture at Buckingham Palace on March 20, the following officers of the Imperial Japanese Naval Air Mission had the honour of being received by His Majesty :—Rear-Admiral K. Yoshida, Eng.-Commander K. Kitajima, Lieut.-Commander S. Kono, Lieut.-Commander T. Ohzeki, and Lieut.-Commander S. Hayashi.

The parents of Sec. Lieut. DONALD C. TUCKER, R.F.C., 41st Squadron, 13th Wing, reported missing March 24, 1918, and who was last seen in an air fight over Bapaume, will be most grateful for definite information as to his fate. Letters should be sent to Durley Park House, Kevnsham, Somerset.

The will of Maj. ERNEST WILLIS, R.A.F., of Copthall Court, E.C., stockbroker, and Garbrand Hall, Ewell, who died at Malta, has been proved at £25,889.

Air Ministry Appointment

IT is understood that General Swinton is relinquishing his post at the Ministry of Labour, in order to take up an appointment under General Sir F. H. Sykes at the Air Ministry.

A Long Trip by a Non-Rigid

RECENTLY a remarkable long-distance flight over the North Sea was performed by the British non-rigid airship, N.S. 11. The voyage, which took the form of a circuit embracing the coast of Denmark, Schleswig-Holstein, Heligoland, North Germany, and Holland, was characterised by extremely unfavourable weather conditions. The total length of the round trip was 1,285 air miles, the time taken being 40½ hours.

Starting from an airship station on the Firth of Forth at 3.45 p.m. on March 16, the airship laid a straight course for Denmark, the Dogger Bank Noord Lighthouse being passed at 1 a.m. The Lemvig Light Vessel, 370 miles from the base, was picked up at 5 a.m., and turning south, the airship cruised down the coasts of Denmark and Schleswig-Holstein towards Heligoland, which was reached at 8 a.m. Passing at a distance of four miles from the island, a new course was set for the Frisian Islands, and at six o'clock in the evening the airship was off Terschelling, the wind having now attained a speed of 30 knots from the north-west.

After leaving the Dutch coast the wind grew stronger, and one engine broke down. It was decided to hold on, and a "landfall" was made at the North Foreland. By this time petrol was running short owing to the necessity of running at full power earlier in the voyage, and one engine only was running—this on five cylinders out of six. At 8.15 a.m. on March 18 a landing was successfully effected at an aeroplane station close by.

20-Hour Trip by "R 34."

ON March 25, at 12.30 p.m., the rigid airship "R 34," built by Messrs. Beardmore and Co., returned to Inchinnan, Glasgow, after a trip which had lasted nearly 20 hours. Leaving Glasgow at 4.55 p.m. on the previous day, she cruised along the Clyde and then across the Irish Channel to Dublin, then back over the Isle of Man, Barrow-in-Furness, and Liverpool, across the North of England to Selby and Newcastle, re-crossing to Dublin and then home *vid* the Isle of Man to Glasgow.

The New Vickers Airship

SOME details are now available of the new big Vickers airship, which is being built at Barrow. She will have a cubic capacity of 1,200,000 ft., and four engines of the Wolseley-Maybach type, each of 240 nominal b.h.p. The airship will be largely constructed of Vickers' special alloy duralumin, and is designed to fly across the Atlantic, carrying passengers and a crew of 16 men. Four cars are to be attached to the hull for use of the pilots, for control, and machinery. There will be two engines in the forward machinery car, and the propeller can be driven by either or both. The new airship is to be used for patrol work, and is expected to take her first flight in May or June.

Four New Airships

IT is stated that the Admiralty has just placed orders for four new rigid airships with Messrs Beardmore and Co., Messrs. Armstrong, Whitworth and Co., and Messrs. Short, of Bedford. The last-named firm will build two of these aircraft, which are to be bigger than the R 33 and R 34, which have recently made trial flights.

The cost of the vessels will be about a million sterling, and they are expected to surpass any rigid craft yet built in England. They will be 700 ft. in length, have a capacity of 2,500,000 cu. ft., and a lifting power of about 70 tons. They will have a speed of 80 miles an hour.

To Holland by Flying Boat

Two members of the Dutch Aviation Commission, at the conclusion of their visit to this country, returned to Holland on March 17 in two British flying-boats, piloted by officers of the R.A.F. The boats, each carrying a crew of four officers and men, as well as a member of the Commission, left Felixstowe at 10.45 a.m. and landed at Texel at 2 p.m., where the pasengers and crew disembarked the boats being moored for the night. The flying-boats, left Texel again on the following afternoon and landed at Felixstowe at 4.10 p.m.

THE ROYAL AIR FORCE

London Gazette, March 14

Flying Branch

Maj. (actg. Lieut.-Col.) B. F. Moore to be Maj. (A.), from (T.), and relinquishes the actg. rank of Lieut.-Col.; March 4.

The following Majs. (actg. Lieut.-Cols.) to be Majs. (K.B.), and relinquish the actg. rank of Lieut.-Col. on ceasing to be employed as Lieut.-Cols. :—

J. R. Bedwell, M.C., C. H. Stringer; March 10.

Lieut. J. V. Knyaston to be Lieut. (A.), from (T.); Jan. 14.

Prob. Flight Officer W. A. Scott (late R.N.A.S.) is granted a temp. commn. as Sec. Lieut. (A.); Sept. 27, 1918.

The following are granted temp. commns. as Sec. Lieuts. (Obs. Officers) :—A. G. Horlock (Lieut., E. Kent R., T.F.), and to be Hon. Lieut.; April 1, 1918. S. T. Goodman, M.C., D.C.M. (Temp. Capt., R. Fus.); July 6, 1918, and to be Hon. Capt. (substituted for notification in *Gazette* July 12, 1918.

The following relinquish their commns. on ceasing to be employed :—Lieut. H. E. Jones (Lieut., B. Columbia R.); Dec. 6, 1918. Sec. Lieut. (Hon. Lieut.) F. B. Denison (Lieut., C. Ont. R.); Feb. 10. Lieut. J. F. W. Blackall (Lieut., Newfoundland R.); March 6.

The following are transfd. to Unemployed List :—Sec. Lieut. A. V. Britnell, Sec. Lieut. H. McD. Small; Jan. 15. Lieut. F. L. Clark; Jan. 22. Lieut. A. A. Charlesworth; Jan. 25. Sec. Lieut. (Hon. Lieut.) A. M. Campbell; Jan. 26. Lieut. G. H. S. Cregeen; Jan. 27. Lieut. J. Welby; Jan. 28. Sec. Lieut. S. A. Barnett, Lieut. J. G. Carey, Sec. Lieut. P. E. Richardson; Jan. 29. Sec. Lieut. D. A. Cobbald, Sec. Lieut. D. V. Crawley, Maj. S. W. Price, M.C.; Jan. 31. Lieut. (actg. Capt.) H. C. Chambers, Sec. Lieut. A. C. Richmond; Feb. 1. Lieut. (Hon. Capt.) R. I. P. Barker (A.S.C., T.F.), Sec. Lieut. O. Hopkins, Sec. Lieut. (Hon. Lieut.) (actg. Lieut.) M. H. Unwin; Feb. 2. Sec. Lieut. O. V. Judkin; Feb. 5. Sec. Lieut. J. B. Bushe; Feb. 7. Sec. Lieut. C. F. W. Illingworth; Feb. 9. Sec. Lieut. C. W. Calder, Sec. Lieut. A. G. Hatten, Sec. Lieut. A. C. Scott; Feb. 10 Capt. F. H. Creasy, Capt. B. R. Shaw; Feb. 11. Lieut. C. Brown; Feb. 12. Sec. Lieut. G. W. Booth, Sec. Lieut. E. P. Elliot, Sec. Lieut. R. E. Stevens; Feb. 13. Lieut. H. E. Austin, Lieut. W. S. Cattell, Capt. W. C. Parker; Feb. 14. Lieut. W. C. G. Cribbett, Lieut. J. Feather, Lieut. W. Haddow, Sec. Lieut. L. R. Reeves, Sec. Lieut. J. F. Vickerton, Lieut. J. W. Willett; Feb. 15. Lieut. W. A. Amor, Sec. Lieut. A. C. Davis, Lieut. E. B. Humphries, M.C., M.B.E.; Feb. 18. Lieut. A. C. Ball, Lieut. E. B. Crickmore, Sec. Lieut. H. H. Dobson, Lieut. F. E. B. Elsbury, Sec. Lieut. R. F. Finke, Sec. Lieut. G. E. Herring, Lieut. R. G. Hornby, Lieut. F. N. Insoll, Sec. Lieut. (Hon. Lieut.) A. Rothfield, M.C., Lieut. E. H. Stuart; Feb. 19. Sec. Lieut. G. H. Clarke, Sec. Lieut. E. J. Freestone, Sec. Lieut. J. S. Hughson Lieut. F. B. Wilkins; Feb. 20. Lieut. (actg. Capt.) R. Affleck, Lieut. T. E. H. Birley, Sec. Lieut. G. R. Butcher, Sec Lieut. F. G. Forshaw, Sec. Lieut. C. W. Harry, Sec. Lieut. E. W. Renny, Sec. Lieut. W. Trezise, Sec. Lieut. A. G. Ward, Capt. L. E. Wear; Feb. 21. Lieut. (actg. Capt.) J. R. Allen, Sec. Lieut. S. L. F. St. Barbe, Lieut. J. C. Barrett, Sec. Lieut. S. L. Hudson, Sec. Lieut. T. W. Hancox, Sec. Lieut. R. F. Jarrom, Lieut. G. F. Yuill; Feb. 22. Sec. Lieut. H. L. Burley, Sec. Lieut. C. H. Booth, Lieut. J. I. Crofton, Lieut. M. J. R. Duff-Ffe, Lieut. A. Duncan, Sec. Lieut. D. E. Gray (substituted for notification in *Gazette* Feb. 18), Sec. Lieut. J. W. McManamy, Sec. Lieut. R. A. Mills, Sec. Lieut. J. B. Palmeter, Sec. Lieut. C. W. Payne, Lieut. H. C. Vizard; Feb. 23. Sec Lieut. J. C. Collins, Lieut. A. G. McI. Jennings, M.C.; Feb. 24. Sec Lieut. C. P. Bertioli, Lieut. J. R. Landry, Capt. N. J. A. L. Prinsep, Lieut. A. P. Wornum; Feb. 25. Lieut. R. W. Briggs, Sec. Lieut. J. Haddow, Lieut. J. D. Horgan, Lieut. W. F. Jelfis; Feb. 26. Sec. Lieut. S. G. Birch Lieut. M. F. St. Clair-Fowles, Lieut. S. C. Stevens, Capt. T. K. Thyne; Feb. 27. Capt. P. Brewster, D.S.C., Lieut. L. F. Ebbutt, Lieut. D. French, Lieut. H. A. Lovett; Feb. 28. Sec. Lieut. E. A. Bateman, Sec. Lieut. J. B. G. Bradley, Sec. Lieut. B. R. Burns, Sec. Lieut. R. G. A. Colley, Sec. Lieut. R. F. Crossling, Sec. Lieut. G. Herrett, Lieut.-Col. R. P. Williams; March 1. Lieut. W. C. Dale, Sec. Lieut. F. Gough, Lieut. E. C. Harrison, Sec. Lieut. J. E. C. Hornsby, Lieut. A. C. Vallance; March 2. Sec. Lieut. (Hon. Lieut.) A. E. Ansell, Sec. Lieut. E. A. Hearne; March 3. Capt. W. S. R. Bloomfield, Lieut. M. H. Harland; March 4. Sec. Lieut. C. Hinns; March 7. Lieut. H. F. Hazell; March 12.

The following Lieuts. relinquish their commns. on account of ill-health, and are permitted to retain their rank :—J. L. Walton (caused by wounds) Dec. 14, 1918 (substituted for notification in *Gazette* Dec. 13, 1918. A. T. Iaccaci, D.F.C., C. R. O'Hagan, F. T. S. Menendez, F. W. H. Oxley (contracted on active service), H. A. Pickford, A. A. Riches, B. S. Smallman (contracted on active service); March 15.

Lieut. G. Broadbent relinquishes his commn. on account of ill-health caused by wounds; March 15.

The following Sec. Lieuts. relinquish their commns. on account of ill-health and are permitted to retain their rank :—H. H. Bland, S. J. Bolitho, C. H. Edwards; March 15. Sec. Lieut. D. McK. Sheridan resigns his commn.; March 15.

Sec. Lieut. E. H. Maw is antedated in his appointment as Sec. Lieut. (A.); June 30, 1918.

Sec. Lieut. P. W. Adams is antedated in his appointment as Sec. Lieut. (O.); April 20, 1918.

Sec. Lieut. G. G. Travis is antedated in his appointment as Sec. Lieut. (O.); June 1, 1918.

The date Lieut. R. B. Donald relinquished his commn. is March 9, and not as stated in *Gazette* Nov. 8, 1918.

The name of Lieut. L. A. Martin is as now described, and not as stated in *Gazette* Feb. 4.

The surname of Lieut. G. B. Anderton is as now described, and not as stated in *Gazette* Feb. 11.

The notifications in *Gazette* Jan. 28 concerning Sec. Lieuts. W. Bartley and E. E. Jones are cancelled.

Administrative Branch

Capt. H. A. Dawson to be Capt., from (T.); March 3.

Lieuts. to be actg. Capts. whilst employed as Capts. :—R. F. Hamlyn; Sept. 28, 1918 (substituted for notification in *Gazette* Feb. 11. A. W. Grigsby, from (T.); Nov. 1, 1918. H. B. Stutfield; Jan. 30. G. V. Walsh; Feb. 3.

Lieuts. (A.) to be Lieuts. :—C. L. W. Brading; Jan. 6. M. G. Taylor; Jan. 25. J. A. Kirker; Jan. 28. S. E. Gane; Feb. 7. B. R. Perry; Feb. 8. J. S. Andrews, F. G. Baker, A. F. Forsyth, V. Mercer-Smyth, J. A. H. Savage, H. G. Tambling, C. E. Worthington; Feb. 14. A. A. Miles; Feb. 15. T. E. H. Birley, C. D. G. Gray, T. L. Green, L. B. Moor, S. Roche, H. Townsend, H. E. Waters; Feb. 17. C. F. Cunningham, D. Miller, J. Milton, D. M. Rawcliffe; Feb. 18. V. C. Coombs, J. G. Kerr; Feb. 19 A. L. Newell; Feb. 21.

Lieuts. (K.B.) to be Lieuts. :—A. J. Johnston; Oct. 31, 1918. C. H. Hartley; Feb. 20.

Lieuts. (O.) to be Lieuts. :—J. P. Coleman; Aug. 2, 1918. R. T. Robbins; Jan. 28. B. Barton; Feb. 7. L. Marsh; Feb. 10. F. B. Rees; Feb. 17 O. Sherwood; Feb. 18. H. O. Long March 4.

W. J. Beach (Lieut., Lon. R., T.F.) is granted temp. commn. as Lieut.; Sept. 13, 1918.

Sec. Lieuts. to be Sec. Lieuts. from (A.) :—R. C. Rogers; Jan. 22. (Hon. Lieut.) E. Cropper; Jan. 31, and to be Hon. Lieut. G. E. T. Payne, W. F. Blackett, J. S. Stringer; Feb. 14. W. Y. Gothorp; Feb. 15.

Sec. Lieuts. to be Sec. Lieuts. from (O.) :—J. K. Best; Jan. 1. P. C. S. McCrea, (Hon. Lieut.) G. H. P. Whitfield, and to be Hon. Lieut.; Feb. 14. E. Darby; Feb. 15.

Sec. Lieut. T. Temple (late Gen. List, R.F.C., on prob.) is confirmed in his rank as Sec. Lieut.; Oct. 1, 1918.

The following are transfd. to Unemployed List :—Sec. Lieut. A. J. Hall; Jan. 22. Sec. Lieut. W. G. Kingsdon; Jan. 26. Sec. Lieut. T. D. Barnes Jan. 28. Sec. Lieut. F. Griffith; Feb. 4. Capt. M. A. Sargent; Feb. 13 Lieut. (Hon.) J. E. de G. Henniker-Major; Feb. 14. Sec. Lieut. A. P. Manners; Feb. 17. Lieut. (actg. Capt.) J. R. Bingham, Sec. Lieut. E. J. Cotton; Feb. 20. Sec. Lieut. G. H. Gleadow; Feb. 21. Sec. Lieut. W. Cole; Feb. 23. Sec. Lieut. D. R. Samuel; Feb. 25. Sec. Lieut. C. J. Eastaugh; Feb. 26. Sec. Lieut. C. W. Dunford; Feb. 27. Sec. Lieut. (actg. Lieut.) W. J. Spooner; Feb. 28. Sec. Lieut. L. F. Rippon; March 2.

Capt. C. G. Huntriss relinquishes his commn. on account of ill-health, and is permitted to retain his rank; March 15.

The following Lieuts. (Hon. Capt.) relinquish their commns. on account of ill-health, and are permitted to retain the rank of Capt. :—G. B. Lockwood, F. C. Smith; March 15.

Lieut. (actg. Capt.) R. S. W. Dickinson (C. Gds.) relinquishes his commn. on account of ill-health; March 15.

The initials of Capt. B. H. Brodie are as now described, and not as stated in *Gazette* March 7.

The notification in *Gazette* Jan. 28 concerning Capt. J. W. Williams is cancelled.

Technical Branch.

Lieut. E. A. Comeau to be actg. Capt. whilst employed as Capt.; Dec. 6, 1918 (substituted for notifications in *Gazette* Jan. 31 and Feb. 14).

Sec. Lieut. (Hon. Lieut.) E. M. Wood to be actg. Capt. whilst employed as Capt.; Feb. 15 (substituted for notification in *Gazette* Feb. 28).

Sec. Lieuts. to be actg. Capts. whilst employed as Capts. (Grade B.) :—(Hon. Lieut.) (actg. Lieut.) R. C. Graham; April 1, 1918. (Hon. Capt.) F. C. Marsh (substituted for notification in *Gazette* Oct. 29, 1918.) (Hon) Lieut.) (actg. Lieut.) E. G. Seth-Smith; June 1, 1918.

Sec. Lieut. W. Borland to be actg. Lieut. while employed as Lieut. (Grade B.) from (Ad.), and to be actg. Capt. (without pay and allowances of that rank) while specially employed; Feb. 26.

Lieut. J. P. Coleman to be Lieut. (Grade A.) from (Ad.); Nov. 19, 1918.

Lieut. J. J. Little to be Lieut. (Grade B.), from (A.); Oct. 18, 1918.

Lieuts. to be graded for pay as Lieuts. while employed as Lieuts. (Grade A.) :—E. E. Beaumont; April 1, 1918. C. C. Bazell; Oct. 1, 1918

Sec. Lieuts. to be actg. Lieuts. while employed as Lieuts. (Grade A) :—H. P. Strong; May 2, 1918. H. J. Brown, F. W. Wrench; Sept. 1, 1918. F. S. Wainscot; Oct. 1, 1918.

Sec. Lieuts. to be actg. Lieuts. while employed as Lieuts. (Grade B) :—E. I. Davies; June 1, 1918. (Hon. Capt.) W. E. Humphreys; Sept. 17, 1918.

Sec. Lieuts. to be Sec. Lieuts. (Grade A), from (Ad.) :—G. G. Kirby; Dec. 7, 1918. H. W. F. Long; Jan. 1. D. F. Bowering; Jan. 2.

Sec. Lieut. S. Pollard to be Sec. Lieut. (Grade B), from (Ad.); Feb. 14.

The following are transfd. to Unemployed List :—Maj. E. R. Bond, Lieut. T. H. D. Silvers; Jan. 17. Maj. F. S. Creswell, O.B.E.; Jan. 18. Sec. Lieut. H. Stokes; Jan. 22. Lieut. H. H. Cox; Jan. 23. Sec. Lieut. T. Campbell; Jan. 26. Sec. Lieut. A. Forsyth; Jan. 29. Lieut. T. F. Braines; Jan. 30. Sec. Lieut. H. L. Cooper; Feb. 3. Sec. Lieut. J. Binns; Feb. 4. Capt. A. E. Courage; Feb. 5. Lieut. S. E. Devonald, Capt. D. W. Pinkney, Lieut. T. F. Pullein, Capt. J. D. Troup; Feb. 6. Lieut. P. S. Woodroffe; Feb. 7. Sec. Lieut. J. H. M. Stevenson; Feb. 8. Capt. A. A. Scott; Feb. 11. Sec. Lieut. (Hon. Lieut.) W. A. T. Hunter, Sec. Lieut. W. A. E. Lea, Lieut. L. C. Row; Feb. 12. Lieut. P. W. Day, Sec. Lieut. A. B. Fortt, Lieut. E. F. Sutton; Feb. 13. Lieut. (actg. Capt.) P. M. T. Hill, Lieut. G. A. Spencer; Feb. 15. Lieut. F. Grattan, Lieut. H. Tallis; Feb. 17. Sec. Lieut. (Hon. Lieut.) E. E. Chalmers, Sec. Lieut. A. G. Ruthven; Feb. 18. Capt. R. Davidson, Sec. Lieut. E. G. Davison, Sec. Lieut. W. H. Heard; Feb. 19. Sec. Lieut. E. Hulme, Capt. L. O. Spain, Lieut. H. B. Shepherd; Feb. 20. Sec. Lieut. H. C. Bolingbroke, Sec. Lieut. W. C. Stribling; Feb. 21. Sec. Lieut. (Hon. Capt.) C. G. Banister, Sec. Lieut. T. C. Balfour, Lieut. D. McK. Finlayson, Sec. Lieut. W. H. Henstridge; Feb. 22. Sec. Lieut. A. O'Sullivan; Feb. 23. Capt. G. M. B. Dobson, Capt. E. A. Goodwin, Sec. Lieut. G. Probert; Feb. 24. Sec. Lieut. J. J. Dwyer; Feb. 25. Sec. Lieut. H. Freeman, Sec. Lieut. J. R. C. Hamilton; Feb. 27. Sec. Lieut. C. F. P. Davies, Lieut. A. D. H. Foster, Sec. Lieut. F. F. P. Hammond; Feb. 28. Sec. Lieut. S. Aspinall, Sec. Lieut. F. Bunting, Maj. G. Dennison, Maj. C. E. Fairburn, Capt. S. V. Green, Lieut. U. P. Jonckheers, Sec. Lieut. H. J. Keay, Sec. Lieut. (Hon. Lieut.) G. H. Whitaker; March 1. Sec. Lieut. F. B. Jeffries; March 2. Lieut. J. M. Heesem, Capt. R. N. Vyvyan, Capt. H. A. Watts; March 4.

Maj. (actg. Lieut.-Col.) C. Defries relinquishes his commn. on account of ill-health contracted on active service, and is permitted to retain the rank of Lieut.-Col.; March 15.

Maj. J. P. A. Waller relinquishes his commn. on account of ill-health, and is permitted to retain his rank; March 15.

The following Lieuts. relinquish their commns. on account of ill-health, and are permitted to retain their rank :—W. E. Feldwick, S. G. Howard; March 15.

The date of appointment of Sec. Lieut. (actg. Lieut.) W. W. Hammond as actg. Capt. is Nov. 1, 1918, and not as in *Gazette* Feb. 25.

Chaplains' Branch

Rev. Capt. H. Hole is transfd. to Unemployed List; March 1.

Medical Branch

Lieut. J. Walker-Brash to be Capt.; Nov. 16, 1918.

Memoranda

Maj. C. T. Hesketh relinquishes his commn. on ceasing to be employed; Oct. 21, 1918.

Lieut. (actg. Capt.) E. S. Crabtree relinquishes the actg. rank of Capt. on ceasing to be specially employed; March 15.

Lieut. G. Clark to take rank and precedence as if his appointment as Lieut. bore date Feb. 5.

The following are transfd. to Unemployed List, from (S.O.) :—Capt. H. J.

Eller, Lieut.-Col. (actg. Brig.-Genl.) C. H. Whittington, C.M.G., C.B.E.; March 1.

Capt. T. B. Marson relinquishes his commn. on account of ill-health caused by wounds; March 15.

London Gazette, March 18.

The following temporary appointment is made at the Air Ministry :—

Staff Officer, 3rd Class (P.).—Lieut. (actg. Capt.) C. E. Crowne, and to retain the actg. rank of Capt. while so employed; Feb. 27.

Flying Branch.

Maj. R. L. Farley to be actg. Lieut.-Col. whilst employed as Lieut.-Col. (K.B.) Aug. 13, 1918.

Capt. W. Lambert to be actg. Maj. whilst employed as Maj. (K.B.); Aug. 13, 1918.

Lieuts. to be actg. Capts. while employed as Capts. (A.) :—J. H. Cooper; July 1, 1918. H. Daniel, M.C.; July 14, 1918. W. S. Hill-Tout; Aug. 22, 1918. E. B. Humphries, M.B.E., M.C.; Oct. 1, 1918. H. E. Judge; Oct. 26, 1918. G. R. Ashton, C. A. Bouchier, C. S. Ramsay; Nov. 1, 1918. G. H. Langley; Dec. 13, 1918.

Sec. Lieut. J. G. Nash to be actg. Capt. whilst employed as Capt. (A.); Dec. 1, 1918.

Sec. Lieut. (actg. Lieut.) (Hon. Capt.) C. J. P. Copner retains the actg. rank of Lieut. whilst employed as Lieut. (K.B.) from (Ad.); Nov. 8, 1918.

Sec. Lieut. C. W. Harrison to be actg. Lieut. (K.B.) whilst employed as Balloon Comdr.; Oct. 1, 1918.

Lieut. C. W. Sowter to be Lieut. (A.) from (Ad.); March 6.

Sec. Lieut. T. H. Lewis to be Lieut.; March 1.

Sec. Lieut. E. A. Blundell to be Sec. Lieut. (A'ship) from (T.); April 1, 1918.

Prob. Flight Officer A. J. Rankin (late R.N.A.S.) is granted a temp. commn. as Sec. Lieut. (A.); July 15, 1918.

F. J. Parker (Temp. Sec. Lieut., York and Lanc. R.) is granted a temp. commn. as Sec. Lieut. (O.); Aug. 15, 1918.

The following are granted temp. commns. as Sec. Lieuts. (Obs. Officers) (substituted for notification in *Gazette* Feb. 14) :—L. W. Hopkins (Temp. Sec. Lieut., E. Surr. R.), W. A. Westacott (Sec. Lieut., R. W. Kent R., S.R.); Oct. 23, 1918.

The following relinquish their commns. on ceasing to be employed :—Lieut. G. S. Roden (Lieut., Can. Rly. Ser.); Jan. 11. Lieut. (actg. Capt.) A. Sleep (Capt., Can. For.); Jan. 12. Lieut. (actg. Capt.) J. W. G. Clark (Lieut., C. Ont. R.); Jan. 20. Lieut. W. N. Sheffield (Lieut., Manitoba R.); Jan. 28. Lieut. B. H. Kewley (Lieut., Manitoba R.); Jan. 30. Lieut. (Hon. Capt.) W. M. Miller (C. Lond. Yeo., T.F.), Sec. Lieut. H. R. Herbert (Lieut., E. Ont. R.); Feb. 13. Sec. Lieut. (Hon. Capt.) R. R. Layte, M.C. (Capt., Nova Scotia R.); Feb. 17. Lieut. R. Mott (Lieut., Brit. Col. R.); March 1. Sec. Lieut. (Hon. Lieut.) A. H. C. Bruce; March 6.

The following are transfd. to Unemployed List:—Sec. Lieut. A. V. Bromham; Nov. 14, 1918. Lieut. P. McK. Haldimand; Jan. 12. Lieut. H. H. Beddow, Sec. Lieut. A. C. Brown (substituted for notification in *Gazette*, Jan. 28 (Jan. 18). Sec. Lieut. C. G. Burnip (substituted for notification in *Gazette* Feb. 11), Capt. A. J. Carlow, Lieut. F. H. Hudson; Jan. 21. Capt. G. R. Hodgson, A.F.C., Lieut. (Hon. Capt.) E. C. Powell; Jan. 22. Sec. Lieut. W. B. Tretheway; Jan. 24. Sec. Lieut. C. Bartow; Jan. 25. Lieut. C. R. Borkland, Lieut. M. C. Howell, Sec. Lieut. A. V. Owens; Jan. 29. Lieut. R. S. Bell; Jan. 31. Lieut. J. C. C. Cotes (substituted for notification in *Gazette* Feb. 18), Sec. Lieut. W. W. McDavid, Lieut. G. R. Simons, Lieut. J. L. Stocks, Lieut. E. P. Thorne; Feb. 1. Sec. Lieut. L. Rogerson, Sec. Lieut. S. E. Rowley; Feb. 2. Sec. Lieut. C. F. Bailey, Lieut. M. J. Thurston; Feb. 3. Lieut. G. A. Pitt, Lieut. A. B. Taylor; Feb. 4. Sec. Lieut. L. H. Peach, Sec. Lieut. H. R. A. V. Puncher, Sec. Lieut. G. W. Shickle, Sec. Lieut. D. A. Stenhouse; Feb. 5. Sec. Lieut. H. G. B. Booth, Lieut. E. J. T. McWeeney; Feb. 6. Lieut. A. Pilling, Lieut. R. Siddall, Sec. Lieut. T. G. Stubley; Feb. 7. Sec. Lieut. F. Thornton; Feb. 8. Capt. C. J. S. Lea; Feb. 9. Sec. Lieut. F. T. Brown, Lieut. R. L. S. Morrice; Feb. 10, Sec. Lieut. G. Adamson, Lieut. H. W. How, Lieut. H. C. C. Murray, Sec. Lieut. N. Nutton, Lieut. R. K. Sherman; Feb. 11. Lieut. F. H. Glover, Sec. Lieut. (Hon. Maj.) F. H. Humphrys, Sec. Lieut. H. C. Hall, Sec. Lieut. T. G. L. Harris, Capt. J. W. James, Sec. Lieut. W. Millburn, Lieut. W. H. Weller, Lieut. H. D. Wright; Feb. 12. Sec. Lieut. W. J. Delaney, Lieut. M. A. Fisher-Brown, Sec. Lieut. R. F. Glazebrook, Lieut. J. G. Lumley, Capt. W. A. McClatchie, M.C.; Feb. 13. Lieut. (Hon. Maj.) E. C. Carner, D.S.O., Lieut. B. Head, M.C., Sec. Lieut. C. A Moth, Capt. D. C. Page, Lieut. C. M. Powell, Lieut. (actg. Capt.) J. McD. Walker; Feb. 14. Lieut. W. Beer, Sec. Lieut. J. J. Gribbin, Lieut. (actg. Capt.) J. Hodgson, D.F.C.; Feb. 15. Lieut. (actg. Capt.) L. Cummings, Sec. Lieut. A. H. Harrison, Lieut. O. Jones; Feb. 16. Sec. Lieut. M. S. O'Rorke, Capt. R. M. Waddington; Feb. 17. Lieut. E. H. Walker, Sec. Lieut. R. D. Weaving, Sec. Lieut. A. H. Wharrier Feb. 18. Lieut. H. R. W. Brown, Lieut. W. L. Coutts, D.C.M., Sec. Lieut. H. W. Derbyshire, Lieut. H. J. Ellam, Lieut. A. F. Percy, Lieut. A. W. Reynell, Lieut. G. Waugh, Sec. Lieut. H. W. Weedon, Sec. Lieut. V. A. Wheeler Feb. 19. Sec. Lieut. A. G. S. Blake, Lieut. A. R. Crisp, Sec. Lieut. L. J. Cuzner, Lieut. (actg. Capt.) R. N. Hall, M.C., Sec. Lieut. G. Harrison, Sec. Lieut. D. H. Hartness, Sec. Lieut. A. G. Hawkins, Sec. Lieut. W. H. G. M. Ling, Lieut. H. W. Oliver, Sec. Lieut. C. A. Showell, Lieut. J. Surdee, Sec. Lieut. C. Swann, Sec. Lieut. J. D. Young; Feb. 20. Lieut. W. Haigh, Lieut. G. Hegginbottom, Capt. D. Plaistowe, Lieut. H. C. Smith; Feb. 21. Lieut. H. A. Blain, Sec. Lieut. F. W. V. Blommestein, Lieut. W. Munn, Sec. Lieut. J. G. Nash, Sec. Lieut. W. G. S. Searight, Sec. Lieut. W. Simpson; Feb. 22. Sec. Lieut. W. Gibson, Lieut. C. V. Palmer, Lieut. H. D. West, Lieut H. A. Whittaker; Feb. 23. Sec. Lieut. D. F. Grant, Capt. H. M. Yeatman; Feb. 24. Sec. Lieut. J. Dwerryhowse, Lieut. J. G. Hughes, Lieut. A. Jackson, Sec. Lieut. B. Rider, Sec. Lieut. G. A. R. Shilson, Capt. B. G. St. J. Smith; Feb. 25. Sec. Lieut. F. Austin, Sec. Lieut. G. R. Davidson, Lieut. W. W. Fielding, Sec. Lieut. T. James, Lieut. R. H. Johnson, Lieut. H. C. Margrett, Sec. Lieut. W. E. Pilgrim, Sec. Lieut. J. Tremain, Sec. Lieut. H. J. Utley, Sec. Lieut. A. E. White; Feb. 26. Sec. Lieut. A. G. Boland, Lieut. A. F. Chick, Sec. Lieut. E. A. Dew, D.F.C., Lieut. R. B Ellis, Sec, Lieut. P. G. Greenslade, Capt. F. S. Mills, D.S.C., Lieut. C. L. Rayment, D.F.C.; Feb. 27. Sec. Lieut. W. G. Brown, Lieut. (actg. Capt.) J. Cunnliffe, Sec. Lieut. G. H. Pearce. Lieut. E. W. Pickford, Lieut. C. D. Walinck; Feb. 28. Sec. Lieut. (Hon. Lieut.) C. L. Childs, Lieut. G. R. Crammond, Sec Lieut. R. H. S. Grundy, Sec. Lieut. G. B. James, Sec. Lieut. (Hon. Lieut.) A. V. Jones, Lieut. E. Kew, Sec. Lieut. K. P. McGowan, Sec. Lieut. P. E. Sawle, Sec. Lieut. S. G. Shand; March 1. Lieut. B W. Blayney, Capt. E. J. B. How, Capt. C. N. Lowe, M.C., D.F.C., Lieut. E. C. Mogridge, Sec. Lieut. A. F. Moseley, Sec. Lieut. W. V. Philpott, Sec. Lieut. H. J. Pretty, Sec. Lieut. J. Whitteridge; March 2. Lieut. W. P. Brown, Sec. Lieut. C. H. B. Brudenell, Lieut. E. Burton, Sec. Lieut. S. J. E. Callcott, Lieut. G. K. Chadwick, Capt. G. M. Cox, M.C., Sec. Lieut. M. F. McGregor, Sec. Lieut. H. Perkins, Sec. Lieut. L. G. P. Robinson, Capt. W. B. Sincair, Lieut. N. T. Thorneloe, Lieut. R. B. E. Turnbull, Lieut. E. R. Taylor; March 4. Lieut. E. T. Collins, Sec. Lieut. V. Lock, Lieut. (Hon. Capt.) H. E. Reynell, Sec. Leut. J. F. Russel, Capt. W. L. Scandrett, Sec. Lieut. H. Walpole, Lieut. S. E. Whiteley; March 5. Sec. Lieut. G. G. Armstrong, Sec. Lieut. A. B. Bedford, Lieut. J. Buckley, Sec. Lieut. H. C. Clemans, Sec. Lieut. T. C. Cooper, M.C., Sec. Lieut. W. F. F. Harwood, Sec. Lieut. B. McNear, Sec. Lieut. W. T. Randle, Lieut. A. W. Winsor; March 6. Sec. Lieut. T. D. Bell, Sec. Lieut. E. J. Thompson, Sec. Lieut. T. Treise; March 7. Lieut. W. G. Ruggins; March 9, Lieut. E. P. Crossen; March 12.

Capt. P. E. Ridewood relinquishes his commn. on account of wounds contracted on active service; March 19.

The following Lieuts. relinquish their commns. on account of ill-health and are permitted to retain their rank :—R. Dolman, T. W. Gowland, T. H. Holmes, F. E. Hobson, O. B. Swart; March 19.

The following Sec. Lieuts. relinquish their commns. on account of ill-health and are permitted to retain their rank :—A. S. Helmer; March 8 (substituted for notification in *Gazette* Jan. 14). N. C. B. Carrick, M. S. Dickinson, W. H. Sawyer; March 19.

The date of appointment of Maj. E. Dalziel is May 6, 1918, and not as stated in *Gazette* March 11.

Lieut. R. A. Crandall is antedated in his appointment as Lieut. (O.) April 1, 1918.

The surname of F. D. Levy is as now described, and not as stated in *Gazette* March 11.

The notification in *Gazette* Jan. 31 concerning Lieut. A. L. Code is cancelled.

Administrative Branch

H. E. J. Hewitt (Temp. Maj., K.R.R.C.) is granted a temp. commn. as Maj.; Oct. 29, 1918, seniority April 1, 1918.

Lieuts. to be actg. Capts. while employed as Capts. :—Hon. Capt. F. Allen; Oct. 16, 1918. A. J. Clark, from Oct. 27, 1918, to Jan. 5; A. J. Barber; Dec. 21, 1918.

Sec. Lieut. C. W. Probets to be actg. Capt. while employed as Capt. from (T.); Sept. 9, 1918.

Lieuts. (A.) to be Lieuts. :—B. H. McCormack; June 13, 1918. A. T. Croucher; Oct. 15, 1918. L. T. Onslow; Oct. 28, 1918. W. Jaffray; Nov. 22, 1918. A. P. Cragg; Dec. 4, 1918. J. H. F. Hambly; Dec. 12, 1918. A. Pascoe; Dec. 20, 1918. A. E. Burton; Jan. 3. W. D. Boehrer; Jan. 7. J. W. Parsons; Jan. 9. C. W. Beatty; Jan. 14. F. St. K. Anderson, R. W. G. Morrison; Jan. 22. J. R. S. Spearing; Feb. 1. M. C. Mosson, A.F.C.; Feb. 4. (Actg. Capt.) P. B. Pattison; Feb. 7, and relinquishes the actg. rank of Capt.

Lieuts. (K.B.) to be Lieuts. :—W. H. Chatham; Dec. 20, 1918. E. G. Boulenger; Jan. 7.

Sec. Lieuts. to be actg. Lieuts. while employed as Lieuts. :—H. N. Turner, Sept. 1, 1918. G. E. Blake; Oct. 21, 1918.

Sec. Lieuts. to be Sec. Lieuts. from (A.) :—A. C. Lamb; Jan. 6. J. Hunter; Jan. 10. A. J. Newnham; Jan. 20.

Sec. Lieuts. to be Sec. Lieuts., from (A. and S.) :—V. C. S. Bach; Nov. 23, 1918. (Hon. Lieut.) E. J. Leedle; Dec. 12, 1918, and to be Hon. Lieut.; Sec. Lieut. H. Perkins to be Sec. Lieut., from (A'ship); Jan. 7.

Sec. Lieuts. to be Sec. Lieuts., from (O.) :—W. T. Wreford; Nov. 19, 1918. R. W. Turner, D.F.C.; Nov. 27, 1918. M. I. Hough; Jan. 1. J. R. Colquhoun; Jan. 14. A. G. Currington; Jan. 27. V. Lockey; Feb. 11.

The following are transfd. to Unemployed List :—Sec. Lieut. W. S. Brown; Capt. E. W. Hall; Jan. 17. Sec. Lieut. W. A. Bennett; Jan. 21. Sec. Lieut. W. L. Milburn; Jan. 27. Capt. E. Clough, Sec. Lieut. A. Todd; Jan. 28. Capt. W. S. Wilson; Feb. 1. Sec. Lieut. W. Bagster, Sec. Lieut. J. Moston; Feb. 2. Sec. Lieut. E. J. Burton; Feb. 5. Sec. Lieut. B. B. Brown; Feb. 6. Sec. Lieut. F. Belcher, Sec. Lieut. H. G. Biltcliffe; Feb. 10. Sec. Lieut. H. V. Hall; Feb. 12. Sec. Lieut. L. N. Bubier; Feb. 19. Sec. Lieut. C. H. Greswell, Sec. Lieut. G. R. Price Feb. 20. Sec. Lieut. G. M. Ashwell, Lieut. W. J. Hatcher, Sec. Lieut. W. H. Smallwood; Feb. 22. Sec. Lieut. H. E. Ilott, Sec. Lieut. C. E. Ray; Feb. 23. Lieut. G. W. Elderkin, Sec. Lieut. W. A. Haw, Sec. Lieut. F. G. L. Robinson; Feb. 24. Sec. Lieut. G. W. Detmold, Sec. Lieut. J. Howard, Sec. Lieut. J. P Pickford; Feb. 25. Sec. Lieut. A. E Ashley, Sec. Lieut. F. L. Dadd; Feb. 26. Sec. Lieut. J. E. Bird; Feb. 28. Sec. Lieut. E. R. Cox, Sec. Lieut. J. C. Crunden, Capt. D. E. Garnett, Lieut. (actg. Maj.) N McArthur, Sec. Lieut. J. Nairn; March 1. Sec. Lieut. D. E. Court; March 2. Sec. Lieut. D. J. Brooks; March 3. Sec. Lieut. E. P. Beard, Lieut. E. H. Billinghurst, Capt. R. Dinwoodie, Sec. Lieut. G. T. Jerome, Sec. Lieut. E. V. Tucker; March 4. Capt. J. W. J. Cremlyn; March 6. Sec. Lieut. J. G. Bennett; March 7.

Lieut. (Hon. Capt.) F. H. H. Miles (Capt., Lon. Yeo., T.F.), relinquishes his commn. on account of ill-health contracted on active service; March 19.

Lieuts. relinquish their commns. on account of ill-health contracted on active service, and are permitted to retain their rank :—H. E. Wild, D. A. Wright; March 19.

The surname of Lieut. W. G. Hurrell, D.F.C., is as now described, and not as stated in *Gazette* Feb. 4.

The initials of Lieut. A. O. Matt are as now described, and not as stated in *Gazette* of Feb. 25.

Technical Branch

Maj. A. S. Morris, O.B.E., to be actg. Lieut.-Col. whilst employed as Lieut.-Col. (Grade A); Sept. 9, 1918.

Capts. to be actg. Majs. whilst employed as Majs. (Grade A)—C. G. Nevatt, W. E. Smith; Sept. 9, 1918.

Lieuts. to be actg. Capts. while employed as Capts. (Grade A) :—C. W. Duffield; Nov. 30, 1918. W. D. Squire; Dec. 1, 1918.

Lieut. (Hon. Capt.) (Actg. Capt.) J. Ramsay, M.C., retains actg. rank of Capt. while employed as Capt. (Grade B) from (Ad.); Oct. 1, 1918.

Lieut. O. W. de Putron to be Actg. Capt. while employed as Capt. (Grade B); Nov. 1, 1918.

Lieuts. to be Lieuts. (Grade B) :—T. W. Cave, M.C. (from O.), F. P. Watts from (Ad.); Jan. 4.

Sec. Lieut. (actg. Lieut.) F. H. Goodwin to be Lieut.; Dec. 12, 1918.

Sec. Lieut. A. J. Allen to be actg. Lieut. while employed as Lieut.; Dec. 1, 1918.

Sec. Lieuts. to be actg. Lieuts. while employed as Lieuts. (Grade A.) :—M. F. Tomkins; June 1, 1918. H. F. Weet; Oct. 1, 1918. (Hon. Lieut.) S. Herbert; Oct. 16, 1918. (Hon. Lieut.) W. E. Jones; Dec. 1, 1918.

Sec. Lieuts. to be actg. Lieuts. while employed as Lieuts. (Grade B) :—H. Fraser, B. Freeman; June 7, 1918. W. Gardner (No. 9041); July 19, 1918. (Hon. Lieut.) W. H. O. Jones; Sept. 28, 1918. (Hon. Lieut.) M. R. Preece; Sept. 29, 1918. C. Littlejohn, from (Ad.); Oct. 1, 1918. J. W. Atkinson; Oct. 16, 1918. G. J. Finley; Nov. 23, 1918.

Sec. Lieuts. to be Sec. Lieuts. (Grade A.) from (Ad.) :—R. O. Griffith; Dec. 7, 1918. S. H. Ewins; Dec. 28, 1918.

Sec. Lieuts. to be Sec. Lieuts. (Grade A) from (Ad.) :—C. H. Bunn Dec. 1, 1918. J. L. Ingham, F. H. Swoffer, J. Tunbridge; Jan. 4. C. E. Easton; Jan. 14. L. J. Slack; Jan. 18. C. M. Byham; Jan. 28. G. H. Stanley; Feb. 25. H. S. Smith; March 5.

The following are transfd. to Unemployed List :—Lieut. (actg. Capt.) F. A. Roberts; Jan. 2. Capt. T. S. R. Blunt; Jan. 13. Sec. Lieut. (Hon. Lieut.) T. J. Benson; Jan. 16. Sec. Lieut. A. C. Blackmore; Jan. 17. Sec. Lieut. (Hon. Lieut.) G. Oliver; Jan. 18. Capt. G. G. Smith; Jan. 23. Sec. Lieut. (actg. Lieut.) H. D. Oliver; Jan. 27. Lieut. J. H. Falconer; Jan. 28. Sec. Lieut. A. R. Russell; Jan. 29. Lieut. L. H. Chamberlain; Feb. 1. Lieut. R. Tyzack; Feb. 4. Sec. Lieut F. L. Tomlinson; Feb. 5. Lieut. F. M. Howard; Feb. 8. Capt. T. J. Offer; Feb. 9. Sec. Lieut. J. E. Liddiatt; Feb. 10. Lieut. D. G. Moreton; Feb. 12. Sec. Lieut. L. N. Jarvis; Feb. 13. Lieut. R. J. Cowan; Feb. 15. Sec. Lieut. A. C. Parnacott; Feb. 17. Sec.

Lieut. O. H. Shenstone; Feb. 18. Sec. Lieut. H. Jenks; Feb. 19. Sec. Lieut. J. A. Graham, Lieut. E. J. Phelps; Feb. 20. Sec. Lieut. L. C. Owen, Capt. (actg. Maj.) F. E. Pollard; Feb. 21. Capt. H. O. P. Hammond, Sec. Lieut. F. P. Reavey; Feb. 23. Sec. Lieut. (actg. Lieut.) E. D. Jones; Feb. 24. Lieut. A. Ginger, Sec. Lieut. R. E. H. Heenan, Lieut. C. H. Holcroft, Lieut. H. R. Horswill, Sec. Lieut. L. Shears; Feb. 25. Sec. Lieut. (Hon. Lieut.) H. F. M. Nash; Feb. 26. Sec. Lieut. J. H. Davie, Sec. Lieut. L. R. Paget, Lieut. (actg. Capt.) G. C. C. Pentland, Sec. Lieut. T. H. Price, Lieut. W. A. Syme; Feb. 28. Capt. J. B. Butler, Sec. Lieut. G. W. U. Clissold, Sec. Lieut. (Hon. Lieut.) C. H. W. Cross, Capt. P. G. Emery, Lieut. (actg. Capt.) A. R. Jackson, Capt. S. R. Mullard, M.B.E., Sec. Lieut. J. Pritchard, Lieut. P. E. Scrivener; March 1. Sec. Lieut. W. G. Blackmore, Lieut. E. W. Kemp; March 2. Maj. J. G. T. Crawford, Lieut. C. Cadman; March 3. Sec. Lieut. C. L. Hales, Sec. Lieut. (Hon. Lieut.) E. F. Hall; March 4. Sec. Lieut. C. F. Dakin, Capt. J. D. Fry, Lieut. J. B. Gass, Lieut. B. Walker, Capt. J. R. H. Whiston; March 5. Sec. Lieut. W. T. Bodger, Sec. Lieut. R. W. Selby, Lieut. T. P. Shillcock; March 6. Sec. Lieut. J. Calderwood, Sec. Lieut. (Hon. Lieut.) F. Meixner; March 7. Maj. D. C. Willock; March 16.

Lieut. (actg. Capt.) H. T. Woodhead relinquishes his commn. on account of ill-health, and is permitted to retain rank of Capt.; March 16.

Sec. Lieut. (Hon. Lieut.) A. L. Curtis relinquishes his commn. on account of ill-health contracted on active service, and is permitted to retain rank of Lieut.; March 19.

Sec. Lieut. (Hon. Lieut.) (actg. Lieut.) A. C. H. Dashwood (R. Fus.) relinquishes his commn. on account of ill-health; March 19.

Sec. Lieut. W. Godfray relinquishes his commn. on account of ill-health, and is permitted to retain his rank; March 19.

The date of appointment of Lieut. (Hon. Capt.) F. Grave as actg. Capt. (Grade B) is Aug. 1, 1918, and not as stated in *Gazette* Feb. 11.

The Christian names of Sec. Lieut. (actg. Capt.) Charles Henry Ball are as now described, and not as stated in *Gazette* Jan. 31.

Medical Branch

The following are transfd. to Unemployed List:—Lieut. W. Cahill; Feb. 27. Capt. R. E. V. Hale; Feb. 28. Capt. H. G. Sutherland; March 4.

Lieut. O. S. Martin relinquishes his commn. on account of ill-health, and is permitted to retain his rank; March 19.

Memoranda

Lieuts. to be Hon. Capts.:—(Actg. Capt.) B. F. G. Cunliffe, J. Gerrard.

Sec. Lieut. R. V. Weeks is granted the hon. rank of Lieut.; May 22, 1918.

The following are transfd. to Unemployed List from (S.O.):—Lieut. (actg. Maj. P. C. Simmons; Jan. 19 (substituted for notification in *Gazette*, Feb. 14). Sec. Lieut. (actg. Capt.) C. A. Perry; Jan. 30. Lieut. (actg. Capt.) J. S. Stooke-Vaughan; Feb. 3. Capt. T. E. Grant; Feb. 6. Capt. (actg. Maj.) J. W. Burt; Feb. 10. Maj. (Hon. Lieut.-Col.) F. H. L. Errington, C.B.; Feb. 12. Capt. A. O. Betts, Maj. (actg. Lieut.-Col.) G. D. Hannay, O.B.E. Lieut. (actg. Capt.) C. J. W. Hosken; March 1. Lieut. (actg. Capt.) R. A. W. Collett; March 2.

Capt. A. J. Mann relinquishes his commn. on account of ill-health contracted on active service, and is permitted to retain his rank; March 19.

London Gazette, March 21.

The following temporary appointments are made:—

Staff Officers (2nd Class), and to be actg. Majs. while so employed:—(Air.) Lieut. (Hon. Capt.) (actg. Capt.) W. Reid; Dec. 30, 1918. (P.) Capt. C. B. Baker; Nov. 18, 1918.

Flying Branch

Capt. (actg. Maj.) C. F. Gordon, O.B.E., M.C., to be Capt. (O.) from (S.O.) and relinquishes the actg. rank of Maj.; Oct. 11, 1918.

Lieuts. to be actg. Capts. while employed as Capts. (A.):—W. J. Butler, C. A. Farquharson, R. L. Lyster-Smythe, C. B. Van-Leanof, F. V. Way, A.F.C., E. W. White; Dec. 1, 1918.

Lieut. Gwyne Lea to be Lieut. (A.) from (Ad.); July 5, 1918.

Lieut. G. C. Mumford, to be Lieut. (O.) from (A.); June 22, 1918.

Sec. Lieut. E. Nordberg to be Lieut.; April 2, 1918.

P. S. M. Wilkinson (Temp. Capt., Hamps. R., attd. Wilts R.) is granted a temp. commn. as Sec. Lieut. (A.), and to be Hon. Capt.; Nov. 7, 1918.

Sec. Lieut. C. G. Gowing (late Gen. List, R.F.C., on prob.) is confirmed in his rank as Sec. Lieut. (A.); July 26, 1918.

The following are granted temp. commns. as Sec. Lieuts. (Obs. Officers):—W. Woodstack (Lieut., R.F.A., S.R.), and to be Hon. Lieut.; June 20, 1918 (substituted for notification in *Gazette* Feb. 14). E. E. Carrall-Wilcocks (Temp. Capt., R. Fus., attd. Staff. R.), and to be Hon. Capt.; Oct. 17, 1918.

The following are removed the Service, His Majesty having no further occasion for their services as officers:—Sec. Lieut. C. P. Buker; Dec. 21, 1918. Capt. H. G. Boswell, D.S.C.; March 22.

The following relinquish their commns. on ceasing to be employed:—Lieut. W. J. McMahon (Lieut., Cent. Ont. R.); Dec. 16, 1918 (substituted for notification in *Gazette* Jan. 28, concerning Lieut. W. J. McMahon (Can. For. Corps); Lieut. D. S. Weld (Lieut., W. Ont. R.); Jan. 3. Sec. Lieut. W. S. Vipond (Lieut., Can. Conting.); Jan. 20. Lieut. F. M. Crawford (Lieut., E. Ont. R.); Jan. 29. Lieut. I. O. Chantler (Lieut., Sask. R.); Feb. 20. Sec. Lieut. (Hon. Lieut.) F. McGraw (Lieut., B. Col. R.), Sec. Lieut. L. F. Stevenson (Lieut., Quebec. R.); Feb. 24.

The following are transfd. to Unemployed List:—Capt. T. Ellis, Sec. Lieut. A. S. Wilson; Jan. 15. Lieut. A. W. Gardiner; Jan. 19. Lieut. R. G. Bundey, Sec. Lieut. C. W. Hurst, Lieut. C. Marriott; Jan. 21. Sec. Lieut. A. Martin; Jan. 22. Lieut. W. L. Bing; Jan. 23. Maj. F. H. Swann; Sec. Lieut. G. Grisdale; Jan. 26. Sec. Lieut. S. J. Graham; Jan. 27. Sec. Lieut. D. V. Beckingham, Capt. W. C. Gage; Jan. 31. Sec. Lieut. W. Davies, Sec. Lieut. S. Jones; Feb. 1. Sec. Lieut. S. R. Ellis; Feb. 2. Capt. H. L. Despard; Feb. 4. Sec. Lieut. W. S. T. Le May, Sec. Lieut. M. Walker, Sec. Lieut. A. F. Waltzinger, Lieut. E. F. Worthington; Feb. 5. Lieut. A. G. Graves, Sec. Lieut. H. Murray, Sec. Lieut. J. W. Pope; Feb. 6. Sec. Lieut. A. W. R. Evans, Lieut. J. E. Frost; Feb. 8. Capt. S. Cockerell, Lieut. C. McPhail, Sec. Lieut. C. F. Wandsworth; Feb. 9. Sec. Lieut. E. M. Lomax, Sec. Lieut. F. E. Peters, Sec. Lieut. H. T. Ross; Feb. 10. Lieut. A. T. Eason; Feb. 11. Lieut. J. Drew, Sec. Lieut. (Hon. Lieut.) J. R. Houghton, Lieut. S. Wittington; Feb. 12. Lieut. C. Fry, Lieut. J. L. S. Fry, Lieut. A. S. Graves, Lieut. F. Shingleton; Feb. 13. Sec. Lieut. E. C. Mathews, Sec. Lieut. J. A. Whitehead, Lieut. W. H. Winter; Feb. 14. Lieut. J. C. Macgown, Sec. Lieut. C. E. Mason, Lieut. B. D. Nicholson, Lieut. H. H. Wall; Feb. 15. R. H. Fotherington, Sec. Lieut. G. J. Lewin, Maj. K. D. P. Murray, M.C.; Feb. 16. Capt. E. E. Bennett, Lieut. C. H. Bird, Lieut. N. Bury, Sec. Lieut. C. E. Faulkner, Lieut. (actg. Capt.) G. A. D. Hancock, Sec. Lieut. H. D. Johnson, Lieut. (actg. Capt.) J. M. McClerry; Feb. 18. Sec. Lieut. F. T. Briggs, Sec. Lieut. O. L. Frampton, Capt. G. G. G. Hodge, Sec. Lieut. A. E. Johnson, Sec. Lieut. F. C. Littleboy, Sec. Lieut. F. D. Marshall, Capt. T. L. Purdon, M.C., Sec. Lieut. F. H. Paulton; Feb. 19. Capt. G. G. Boyton, Sec. Lieut. F. W. Jones, Sec. Lieut. P. J. Pitts; Feb. 20. Lieut. A. A. Green, Sec. Lieut. R. C. Mills; Feb. 21. Sec. Lieut. J. L. Goss, Sec. Lieut. H. A. McKay, Sec. Lieut. N. S. Muir, Sec. Lieut. W. W. W. Walker, Lieut. A. W. Young; Feb. 22. Sec. Lieut. L. A. W. Galloway, Lieut. J. A. MacGregor, Lieut. A. G. Pointing, Sec. Lieut. A. Sowdon, Sec. Lieut. H. F. Walters; Feb. 23. Capt. A. E. Popham, Sec. Lieut. T. R. Walkington, Sec. Lieut. O. C. S. Wallace; Feb. 24. Lieut. J. Brydone, Sec. Lieut. W. H. C. Gillett, Capt. F. Godfrey, Lieut. C. B. E. Lloyd, Lieut. W. B. Melville, Sec. Lieut. R. P. Stockton; Feb. 25. Lieut. A. E. Baker, Sec. Lieut. L. H. W. Gascoigne, Lieut. T. W. Kneale, Lieut. (Hon. Capt.) (actg. Capt.) D. Watson; Feb. 26. Lieut. H. E. Dempsey, Sec. Lieut. A. H. Farrington, Sec. Lieut. A. E. Sherwood, Lieut. G. M. Yuill; Feb. 27. Sec. Lieut. (Hon. Lieut.) G. B. Baird, Lieut. K. C. Bass, Sec. Lieut. E. Bower, Lieut. F. C. Edwardes, Lieut. W. E. Hall, Sec. Lieut. H. J. Humphrey, Sec. Lieut. C. A. Newham, Lieut. (Hon. Capt.) J. C. Perkins, Capt. F. A. M. Rawes, Lieut. A. H. Warton, Sec. Lieut. A. F. Webster; Feb. 28. Lieut. (actg. Capt.) J. P. Barnes, Lieut. F. S. C. Buchanan, Lieut. J. B. Birkhead, Lieut. H. Dillon, Lieut. R. L. Golds, Sec. Lieut. T. I. Goodall, Lieut. N. W. Hamilton, Sec. Lieut. W. F. List, Sec. Lieut. J. McLelland, Sec. Lieut. R. R. Mason, Sec. Lieut. C. C. Rollason, Capt. W. Smith, M.C., Lieut. A. G. Wingate-Gray; March 1. Capt. J. D. Atkinson, A. F. C., Capt. T. C. Chamberlain, Lieut. (Actg. Capt.), S. W. Highwood, Lieut. A. R. Hunt, Lieut. H. F. Mase, Sec. Lieut. H. Seddon, March 2. Sec. Lieut. H. E. J. Steele; March 3. Lieut. S. S. Alder, Sec. Lieut. G. Bradley, Sec. Lieut. R. D. Broad, Capt. D. N. Drybrough, Sec. Lieut. H. Davies, Sec. Lieut. H. M. Feltham, Sec. Lieut. W. Gilbert, Sec. Lieut. J. E. Glover, Lieut. H. S. Green, Sec. Lieut. F. S. Griffis, Lieut. J. W. Mawbey, M.C.; March 4. Lieut. S. F. Allabarton, Sec. Lieut. S. W. Beckett, Sec. Lieut. R. A. Gunther, Lieut. D. G. Heady, Sec. Lieut. G. C. Jeremiah, Lieut. H. S. Laing, Sec. Lieut. C. G. Rich; March 5. Lieut. N. S. McConnell, Sec. Lieut. R. Roberts, Sec. Lieut. W. Sutcliffe, Lieut. J. H. R. Sutherland, Sec. Lieut. J. L. Warmington; March 6. Sec. Lieut. C. L. Bowley, Capt. H. J. Brewster, Sec. Lieut. R. Boosey, Capt. J. M. R. Cripps, Lieut. S. W. Cubitt, Sec. Lieut. G. G. Duddell, Sec. Lieut. F. C. Edney-Hayter, Lieut. J. H. Hardman, Sec. Lieut. O. A. Kempe, Lieut. (actg. Capt.) R. G. W. Martin, Sec. Lieut. C. W. Martin, Sec. Lieut. A. R. Pengilly, Sec. Lieut. H. Park, Lieut. D. L. Reed, Lieut. A. W. D. Stackhouse, Lieut. G. S. Shepherdson; March 7. Sec. Lieut. J. Briscoe, Sec. Lieut. T. Dowsett, Sec. Lieut. H. Enzlin, Sec. Lieut. P. D. Fenton, Sec. Lieut. T. C. Herman, Sec. Lieut. R. A. Higgins, Lieut. J. R. Holden, Sec. Lieut. W. F. Jagger, Sec. Lieut. W. I. Jones, Sec. Lieut. G. E. S. Lamb, Sec. Lieut. A. Low, Sec. Lieut. E. A. Liggins, Lieut. G. W. Platt, Lieut. J. A. Percy, Sec. Lieut. S. Richards, Sec. Lieut. G. V. Young; March 8. Sec. Lieut. B. E. Drane, Lieut. R. W. Hemsley, Sec. Lieut. W. Leithead, Sec. Lieut. H. K. Wilson, Sec. Lieut. J. R. Watkins; March 9. Lieut. (actg. Capt.) F. N. Chadwick, Sec. Lieut. M. R. Haseler, Sec. Lieut. H. S. Rowland; March 10. Lieut. P. G. Ashford, Lieut. (Hon. Capt.) J. M. Beaufort, Lieut. F. L. Chapple, Sec. Lieut. P. B. Pierce, Sec. Lieut. A. Petty; March 11. Lieut. (actg. Capt.) B. E. Barnum, Sec. Lieut. I. W. Dunbar, Sec. Lieut. F. F. G. Hepworth, Sec. Lieut. (Hon. Lieut.) S. B. Moir, Lieut. R. B. B. Sovier, M.C.; March 12. Capt. E. A. Lloyd; March 13. Sec. Lieut. D. V. McLeod; March 17.

Maj. J. P. Wilson, D.S.C., A.F.C., relinquishes his commn. on account of ill-health, and is permitted to retain his rank; March 22.

Capt. C. R. Clapperton (R.G.A., T.F.) relinquishes his commn. on account of ill-health contracted on active service; March 22.

The following Lieuts. relinquish their commns. on account of ill-health, and are permitted to retain their rank:—S. F. Napper, W. T. Simpson, J. Valentine (caused by wounds); March 22.

The following Lieuts. relinquish their commns. on account of ill-health:—E. H. Millington (Ches. R., T.F.), H. F. Young (Lancs Fus.), contracted on active service; March 22.

The following Sec. Lieuts. relinquish their commns. on account of ill-health, and are permitted to retain their rank:—N. C. B. Carrick (contracted on active service), G. T. Cunningham, H. Dyson, F. Johnson, E. J. Morris; March 22.

Sec. Lieut. H. W. Minish is antedated in his appointment as Sec. Lieut. (O.); June 4, 1918.

The surname of Lieut. F. D. Levy is as now described, and not as stated in *Gazette* March 11 (substituted for notification in *Gazette* March 18).

Administrative Branch

Capt. H.R.H. Prince Albert, K.G., to be Capt., from (S.O.); March 3.

Lieut. H. F. D. Lane to be actg. Capt. whilst employed as Capt.; July 15, 1918.

Lieuts. (A.) to be Lieuts.:—(Hon. Capt.) N. Robertson; Nov. 23, 1918. N. A. Birks; Feb. 15. A. L. Garrett; Feb. 25.

C. S. Marriott (temp. Lieut., attd. Lancs Fus.) is granted a temp. commn. as Lieut.; July 12, 1918, seniority from April 1, 1918 (substituted for notifications in *Gazettes* Nov. 8, 1918, and Jan. 21.

Sec. Lieut. J. Sadler relinquishes his commn. on ceasing to be employed; Nov. 19, 1918.

The following are transfd. to Unemployed List:—Lieut. T. Bullough; Jan. 10. Sec. Lieut. T. Scott; Jan. 28. Lieut. G. Bevis; Feb. 1. Lieut. W. A. J. Gribble; Feb. 4 (substituted for notification in *Gazette*, Feb. 28, concerning Lieut. W. A. John). Sec. Lieut. H. C. Beeton; Feb. 7. Lieut. W. B. Green, D.F.C.; Feb. 14. Sec. Lieut. J. A. Peire; Feb. 16. Sec. Lieut. C. H. Deeks; Feb. 19. Capt. C. G. Darwin, M.C., Sec. Lieut. N. J. Graham; Feb. 21. Lieut. (actg. Capt.) W. J. O. Newton, Sec. Lieut. (actg. Capt.) F. R. T. Pearson; Feb. 22. Lieut. T. A. M. Gardiner; Feb. 23. Sec. Lieut. S. R. Durdin, Lieut. H. N. B. Richards; Feb. 25. Sec. Lieut. G. A. Faulkner, Sec. Lieut. B. McD. Hastings; Feb. 27. Sec. Lieut. L. R. Gibbs, Capt. S. W. Godin, Capt. B. V. Grealy; Feb. 28. Lieut. W. F. Morris; March 1. Sec. Lieut. (Hon. Lieut.) C. L. Childs, Sec. Lieut. A. H. Silver; March 2.

Royal Flying Corps (Military Wing).

London Gazette Supplement, February 26.

Flying Officers.—Temp. Sec. Lieut. F. E. Boulton, Gen. List; Feb. 11 1918.

The date of appointment of Temp. Sec. Lieut. J. N. Clark, Gen. List, is Dec. 24, 1917, and not as in *Gazette* of May 2, 1918.

Instructors in Gunnery (Graded as Equipment Officers, 1st Class).—From Asst. Instrs. in Gunnery (graded as Equipment Officers, 2nd Class):—Temp. Capt. (without the pay and allowances of that rank) G. M. Garro-Jones, Gen. List, and to be Temp. Capt. (with pay and allowances of that rank) whilst so employed; Dec. 18, 1917. Lieut. L. H. Scott, M.C., 8th Midd'x. R., T.F., and to be Temp. Capt. whilst so employed; Jan. 1, 1918.

Equipment Officers, 3rd Class.—Temp. Sec. Lieut. (on prob.) C. G. Gissing, Gen. List, and to be confirmed in his rank; Feb. 19, 1918.

London Gazette Supplement, February 28.

Flying Officer.—The date of appointment of Temp. Sec. Lieut. S. W. Walker, Gen. List, is Feb. 27, 1917, and not as in *Gazette* of April 8, 1918.

Flying Officer (Observer).—The Christian names of Temp. Sec. Lieut. Arthur Samuel Hartley, Gen. List, are as now described, and not as in *Gazette* of May 17, 1918.

London Gazette Supplement, March 4.

Flying Officer (Observer).—Temp. Sec. Lieut. (on prob.) K. E. Tullock, Gen. List, and to be confirmed in his rank; Aug. 28, 1916.

London Gazette Supplement, March 13.

Flying Officers.—Temp. Sec. Lieuts. (on prob.), Gen. List, and to be confirmed in their rank:—A. J. Davis; Nov. 7, 1917. H. P. Dawson, D. S. Anderson, R. Milner, G. D. Robin; Nov. 22, 1917. S. Leith; Nov. 26, 1917. C. B. Henderson, T. H. M. Brown; Nov. 27, 1917. D. M. Johns, L. Mortimore, H. D. Schoeman, E. F. Wright; Nov. 28, 1917.

FLIGHT

SIDE-WINDS

TO ALL who cycle or motor or fly Bowden wire is such a commonplace thing that it will probably surprise many to hear that its manufacture is a series of highly specialised operations. That, however, is evident to anyone privileged to make a tour through the up-to-date works of Messrs. Bowden Wire, Ltd., at Willesden. How many, for instance, would imagine that such a firm would have need for a laboratory, and yet there is one included in the factory, and the works' chemist is kept busy trying to improve the excellent Bowden products. One thing is certain, Bowden Wire, Ltd., is not content to rest upon the laurels garnered during the past twenty-one years, for it "came of age" last December, having been founded under the title of the E. M. Bowden's Patent Syndicate in 1897. Just previous to the outbreak of war the directors had reached the conclusion that they had come to the limit of the capacity of the old works and were on the point of erecting a new factory. Then came the War—and a slump. But they were not dismayed, and within two or three months the demand for Bowden wire set in fiercely. Not only so, but the works were pressed into service for manufacturing sundry other munitions of War. It was among the earliest firms to be "controlled," and in less than a year the need for a larger factory became imperative. In June, 1915, the new site was acquired and within six months the new factory was run up and occupied, the buildings covering an area of two acres. Production never ceased, for engines and machinery were running in the new factory before the old one at Camden Town was vacated. The present buildings comprise a two-storey office and warehouse, behind which are the machine, tool-making, fitting and assembling shops, as well as the inspection, polishing and plating departments. In separate buildings isolated from the other workshops are the laboratory and the canteen—the latter accommodating over 400 persons. During the War many millions of feet of Bowden wire have been supplied to Great Britain and her Allies, and the demand was so great as to gradually cut out the production of other War material. It was used chiefly at first on motor-cycles, then uses were found for it on aeroplanes, submarines, and tanks. It would take too long to detail all the many applications which have been made. For the last two years of the War the output was almost entirely absorbed by the Government. Now they are back again at their old work, and Mr. J. R. Nisbet, the managing director, to whose foresight and ability the success of the firm is largely due, reports that trade is fairly lively. That this is really so is shown by the fact that the works staff is now only about 12 per cent. under its War strength when two shifts were employed. No wonder the firm looks quite hopefully to the future.

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THOSE firms who are out to take their fair share in the boom in trade when it comes realise that it is above all things necessary for them to see that their factory equipment is of the best. This is especially so when rapid and accurate repetition work is concerned. In this connection one firm which is doing a great deal to help the manufacturers is Messrs. F. A. Jennings. Ltd., of Reno Works, Harrow. During the War they have built up a very fine reputation for their automatics for aircraft and aero engine parts, not to mention fuse components. When it is mentioned that the particular work these machines have been engaged upon is from high tension steel, it will be seen that for all commercial requirements in repetition work in either brass, gun-metal or mild steel bars, the machine is quite adequate from the point of view of strength. "Seeing is believing," and the firm offer a cordial invitation to those interested to visit their works and see the machines at work. Not only so, but they are willing and ready to place their experience at the disposition of prospective clients; if a repetition proposition is submitted to them, either sample or drawings, they will undertake to supply their "Reno" automatic machines tooled up and cammed all ready for immediate production work, with spare sets of tools. One important point to bear in mind is that the firm is an entirely British one and their tools are of entirely English manufacture.

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IN connection with the organisation of the English Electric Company, Ltd., which includes an amalgamation of the Coventry Ordnance Works, Ltd., Dick Kerr and Co., Ltd., and the Phœnix Dynamo Manufacturing Co., Ltd., all of whom have been manufacturing aircraft, we understand that it has been decided to concentrate the production of the aircraft work of the English Electric Company at the Thornbury Works of the Phœnix Co., at Bradford, thus combining the efficiency of centralised production with the wide and varied experience of the three firms. This will give them an unique capacity to cater for the post-War aircraft requirements of all kinds, although they specialise more particularly in large flying-boats. Of these they have constructed many types, both official as well as of their own design, and have in hand much larger machines than they have hitherto turned out. They claim that every flying-boat which has been tested and flown from the seaplane base at Brough has been of their manufacture.

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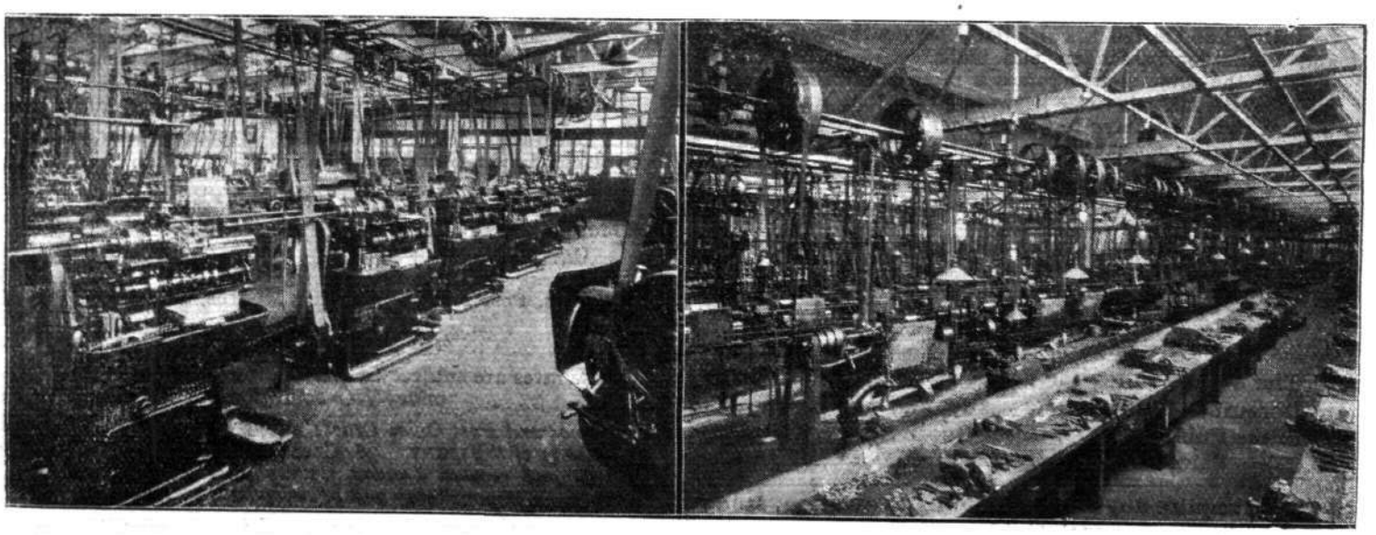
THE directors of the Sunbeam Motor Co., Ltd., recently entertained a number of their staff at a dinner at the Queen's Café, Wolverhampton, a most enjoyable evening being spent. The export manager, Mr. W. A. Priest, in proposing the healths of the joint managing directors, Messrs. W. M. Iliff and Louis Coatalen, dwelt upon the excellent relations which existed between the directors and all members of the *personnel* of the company, resulting in the close and amicable working together of all departments. Mr. H. Massac Buist, in a felicitous speech, declared his belief in the continuous prosperity of the Sunbeam company, and offered his hearty good wishes to that end. Messrs. Iliff and Coatalen suitably replied, and said they would do all they could to promote the best interests of all those employed at the Sunbeam works. Some musical items rendered by members of the staff were much enjoyed.



Two of the shops in the works of Messrs. Bowden Wire, Ltd., at Willesden

NEW COMPANIES REGISTERED

THE ACETRICAL ENGINEERING CO., LTD., 2, Hamilton Street, Greenock.—Capital £5,000, in £1 shares. Business, oxy-acetylene and electric-arc cutting and welding of metal and alloys, engineers, etc. First directors: W. Miller (junr.), L. M. Miller and J. G. Robertson.

ALLIED EXPORTERS, LTD., 76-8, York Street, Buckingham Gate, S.W. 1.—Capital £10,000, in 9,500 shares of £1 and 10,000 shares of 1s. each. Under agreement with R. W. H. Kane, S. S. Sadgrove, the Mansions Motor Co., Ltd., and A. C. Hyatt, exporters, importers, shipowners, carriers, manufacturers of and dealers in aircraft, motor cars, etc. First directors: R. W. H. Kane, and C. W. Sadgrove.

CLUTCHNUT ENGINEERING CO., LTD., 2, Sandland Street, W.C. 1.—Capital £1,000, in £1 shares. Engineering and general inventors, etc., in connection with aeroplanes, hydroplanes and general aircraft, etc. First directors: C. Jefferies and Ida E. Thompson.

RADIO COMMUNICATION CO., LTD., Oswaldestre House, Norfolk Street, W.C.—Capital £200,000, in £1 shares (100,000 preference). Acquiring inventions connected with radio telegraphy and telephony, etc.

PUBLICATIONS RECEIVED

A Text-Book of Aeronautics. By Herman Shaw, B.Sc., A.R.C.S., A.F.Ae.S., etc. London: Charles Griffin and Co., Ltd. Price 10s. 6d. net (postage extra).

The Aircraft Identification Book. By R. Borlase Matthews and G. T. Clarkson. London: Crosby Lockwood and Son. Price 3s. 6d. net.

Airship Attacks on England. By Kapitan-Leutnant von Buttlar. London: J. Selwyn and Co., Ltd., 20, Essex Street, W.C. 2. Price 1s. 3d. net.

Scraps from Life. By Charles Menten. London: McAra and Whiteman, Pear Tree Street, Goswell Road, E.C. Price 3s. 6d.

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Aerial Insurance

Now that the question of insurance of machines, passengers, pilots, goods, etc., is so very much to the fore, we shall be pleased to receive enquiries from companies or individuals interested in the subject, with a view to arranging rates, etc., under Lloyd's policies. Enquiries should be addressed to F. King, Manager, Aerial Insurance Department, 36, Great Queen Street, Kingsway, W.C. 2, who is in a position to quote the lowest market rates.

Resettlement of R.A.F. Personnel

THERE are many officers and men of the R.A.F. who are demobilised or are about to be demobilised.

In order to assist those who are undecided or are seeking advice as to their prospects in civil life, the Editor has arranged for an expert, with wide experience of service, industrial and educational conditions, to give advice to those who may solicit it through the medium of this Journal.

Applications, which must be in writing, should be marked *Resettlement*, and addressed to the Editor, FLIGHT, 36, Great Queen Street, Kingsway, W.C. 2. They will be dealt with in these columns, as far as possible, in rotation.

Air Services in Germany

ACCORDING to a message from Berlin, a German airship company has started a twice-daily service between Leipzig and Berlin for passengers and mails.

From the same source comes a report that the inaugural flight on the new air route between Berlin and Warnemunde, whence there is a ferry to Copenhagen, has been carried out. The time taken for the flight, in spite of the squally weather, was one hour and twenty minutes.

French Relief Service Completed

IT appears that the aeroplane service which has been feeding the districts between Maubeuge, Valenciennes and Vouziers, is nearing the end of its labours, as the traffic on the railways has now become much more regular.

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Index and Title Page for Vol. X.

The 8-page Index for Vol. X of "FLIGHT" (January to December, 1918) is now ready, and can be obtained from the Publishers, 36, Great Queen Street, Kingsway, W.C. 2. Price 8d. per copy, post free.

Aeronautical Patents Published

Abbreviations:—cyl. = cylinder; I.C. = internal combustion; m. = motors.

APPLIED FOR IN 1914

Published March 27, 1919.

23,502. H. B. MOLESWORTH. Directing the dropping of bombs or projectiles from aircraft.
23,790. A. H. EDWARDS. Guns on aeroplanes.
24,351. J. K. WELLS. Sighting-device for aircraft.

APPLIED FOR IN 1915

Published March 27, 1919.

3,009. H. B. MOLESWORTH. Directing the dropping of bombs or projectiles from aircraft.
3,428. C. W. BRADLEY. Sighting-apparatus for dropping bombs from aircraft.
3,867. M. O'GORMAN, S. J. WATERS and E. A. VESSEY. Supporting and releasing bombs, etc., from aircraft.
3,887. BARR AND STROUD, A. BARR and W. STROUD. Sighting-apparatus for dropping bombs from aircraft.
5,030. P. H. DEACON and E. OWEN. Mountings for anti-aircraft guns.
5,750. L. E. COWEY. Sighting-devices for dropping bombs, etc., from aircraft.
5,915. R. WHEATLEY and NORTH BRITISH RUBBER CO. Fabric for balloon envelopes, etc.
6,698. PORTADOWN WEAVING CO. and T. J. GREEVES. Fabrics applicable for aeroplane wings, etc.
6,967. BARR AND STROUD, A. BARR and W. STROUD. Pilot steering-indicators for aircraft.
8,438. G. DE HAVILLAND and AIRCRAFT MANUFACTURING CO. Gun mounting for aircraft.

APPLIED FOR IN 1916

The numbers in brackets are those under which the Specifications will be printed and abridged, etc.

Published March 27, 1919.

2,960. L. O. and H. L. SHORT. Straining devices of the lever type (123,537.)
17,542. CURTISS MOTOR CO. Hydro-aerial machines. (102,620.)

APPLIED FOR IN 1918

The numbers in brackets are those under which the Specifications will be printed and abridged, etc.

Published March 27, 1919.

3,133. J. J. MORCH. Propulsion and control of aeroplanes. (123,564.)
3,135. J. J. MORCH. Propellers for aerial machines. (123,565.)
3,843. C. M. POULSEN. Planes of aeroplanes. (123,603.)
3,867. PRIOR'S AERIAL PATENTS, LTD., and E. G. PRIOR. Keels of airships, etc. (123,604.)
5,300. CELLON, LTD., T. TYRER AND CO., and T. TUCKER. Production of dopes. (123,628.)
5,305. G. H. THOMAS and G. S. WILKINSON. I.C. engines for aircraft. (123,629.)
5,393. SIR W. G. ARMSTRONG, WHITWORTH AND CO., LTD., and R. G. LOCK. Covers for holes in airship fabric. (123,633.)
7,471. J. HALL AND SONS and C. STONEBRIDGE. Containers for dopes, etc. (123,651.)
9,275. H. V. J. JOUFFRET. Radial-cylinder I.C. engines. (121,940.)
13,278. A. T. ALLEN. Bullet-proof guard for aeroplanes. (123,691.)
19,579. SOC. DES MOTEURS SALMSON (SYSTEME CANTON-UNNÉ). Device for fixing engine in aeroplane. (121,463.)

FLIGHT

and The Aircraft Engineer,

36, GREAT QUEEN STREET, KINGSWAY, W.C. 2.

Telegraphic address: Truditur, Westcent, London.
Telephone: Gerrard 1828.

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